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R-2000 Repeater Controller Owner's Manual - Sample Copy

Notice: All user level and P.C.L. codes have been changed in this manual to protect R-2000 owners. This manual is to be used for evaluation only. Some of the material may have been modified or updated.

Version 1.0

5/85

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Warning: This equipment generates and uses radio frequency energy and if not installed and used properly, i.e., in strict accordance with the instructions manual, may cause harmful interference to radio communications. It has been tested and found to comply with the limits for a Class A computing device pursuant to Subpart J of Part 15 of FCC Rules , which are designed to provide reasonable protection against such interference when operated in a commercial environment.

Operation of this equipment in a residential area is likely to cause interference in which case the user at his own expense will be required to take whatever measures may be required to correct the interference.

FCC NOTICE TO USERS

1. Upon request of your telephone utility, you must notify them as follows:

   a. Intention to install an FCC Part 68 registered device.

   b. The FCC registration number.

   c. The ringer equivalence number.

   d. When the device is disconnected from the telco network and will not be reconnected.

2. These units may not be used on party lines.

3. The telco has the right to make changes in their network which may affect the operation of your unit, provided adequate notice is given to you in advance to permit continued correct operation.

4. In the event of operational problems, disconnect your unit by removing the modular plug from the telco modular jack. If your regular phone still works correctly, your R-2000 has a problem and should be returned for repairs (in or out of warranty). If upon disconnection of your R-2000 there is still a problem on the line, notify the telco that they have a problem and request prompt repair service (at no cost to the user).

5. The user may not under any circumstances (in or out of warranty) attempt any service or repairs on the R-2000 repeater controller. It must be returned to the factory for all repairs.

All specifications subject to change without notice.

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INTRODUCTION

Capabilities of the R-2000

The R-2000 repeater controller is one of the most sophisticated controllers on the market today. It is capable of controlling a complete repeater system as well as two remote bases and a control receiver. The repeater receiver and transmitter are interfaced to the controller by means of audio, carrier operated switch (COS) and push to talk (PTT) signals. The remote bases can be of any make transceiver. Our exclusive voice operated switch (VOS) circuits allow the remote bases to be hooked to the controller through the speaker and microphone jacks only. Two PTT signals and optional COS inputs are also provided for the remotes. See the system block diagram on page 3 for details on what can be interfaced to the R-2000.

The R-2000 also has many other features to enhance the operation of your repeater system. These include a full feature autopatch (with autodialer, memory dial, toll restricts and VOS for call progress detection), sub-audible tone decoder, clock/calendar, synthesized voice mailbox system, and input/output ports to interface your controller to other devices. All repeater functions are handled by the microprocessor controller and are completely programmable by the user using touch-tone commands from a transceiver or the phone line. Computer aided design techniques and state of the art components were used in the R-2000 for high reliability operation which is essential for a repeater system. Also available are ports for future expansion of the R-2000. The R-2000 is housed in a standard 19 inch rack mount enclosure 1.75" high. The following is a list of the R-2000's features:

- Fully programmable from any radio or phone
- Supports repeater system as well as two remote base transceivers.
- Programmable sub-audible tone decoder.
- Local microphone/control input.
- Audio monitor for monitoring repeater or phone audio.
- Audio delay line allows for muting of touch-tones and receiver squelch tail.
- Digital voice operated switch (VOS) circuit allows remotes to be connected without having to modify the radio to obtain COS signals.

- Status display for monitoring key signals.

- Easy to use command language uses touch-tone pad on radio or phone to access and program the controller.

- Multi-user capabilities for selected functions.

- Natural sounding speech synthesizer.

- Full or half duplex autopatch with autodialer, toll restrict tables, automatic level control, and call progress detection.

- Automatic repeater and autopatch logging keeps track of repeater usage and phone calls made on the autopatch.

- Real time clock/calendar for time programmable functions and events.

- User mailbox for storing and retrieving messages.

- Eight line input/output port allows control of external devices.

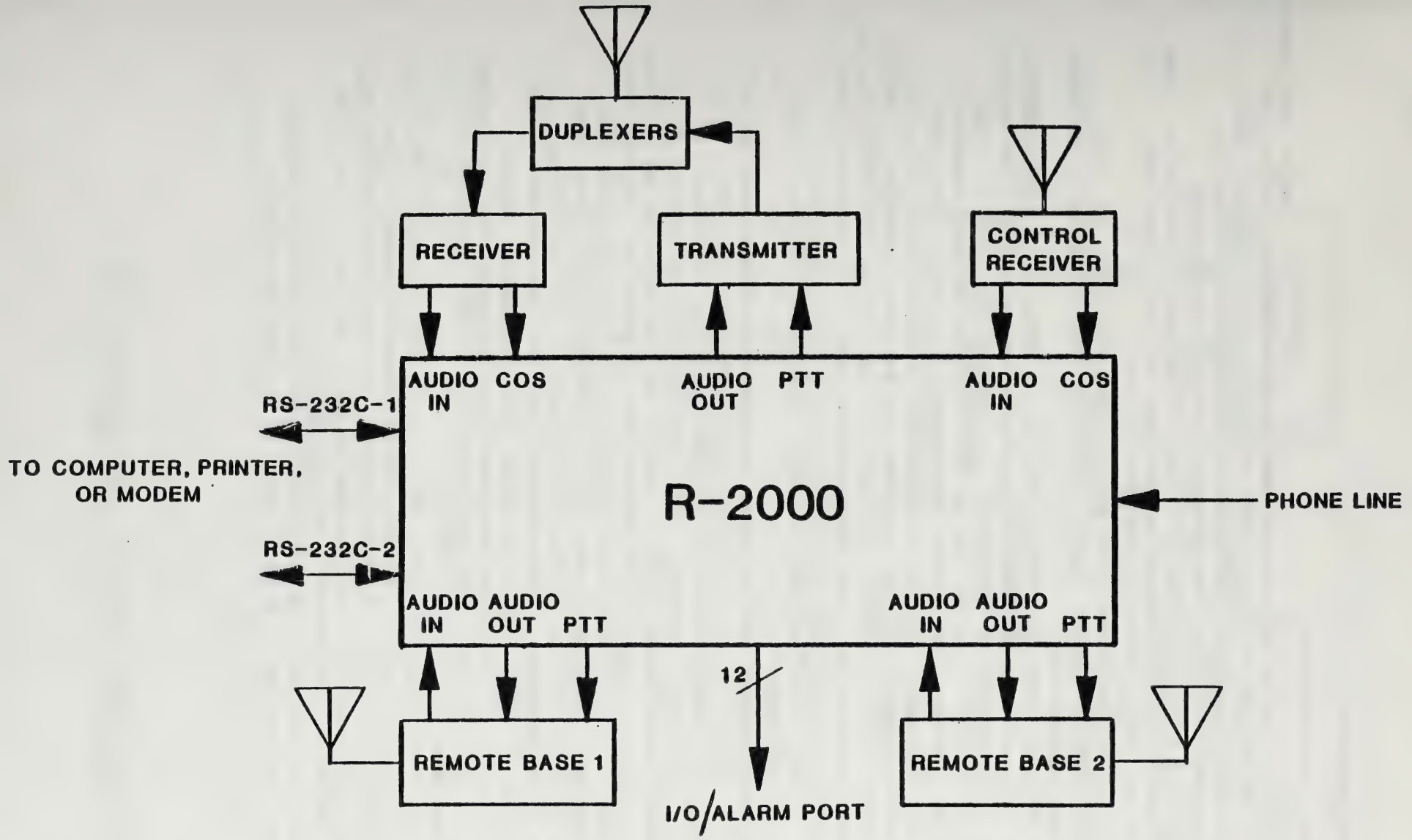
- Four alarm inputs for triggering alarms or controller functions.

- Two RS-232C ports allow interfacing the R-2000 to a computer, printer, modem, or computer controlled transceivers.

- Watchdog circuit for fail-safe operation.

- Uses Rockwell 65C02 4 megahertz microprocessor with 16k bytes of static non-volatile RAM (10 year backup).

- Expandable thru both hardware (audio and microprocessor busses) and software for added flexibility.



SYSTEM BLOCK DIAGRAM

Theory of Operation

The R-2000 is a single board dedicated computer controller capable of replacing relays, timer circuits, I.D. boards, etc. in present repeater systems. It consists of analog and digital circuitry which utilizes integrated circuit and hybrid technologies. A block diagram of the R-2000 controller is on page 5. The following is a description of each of the functional sections of the R-2000.

The controller receives it's power from any 12 - 15 volt source. The on-board power supply provides the necessary voltages to power the controller.

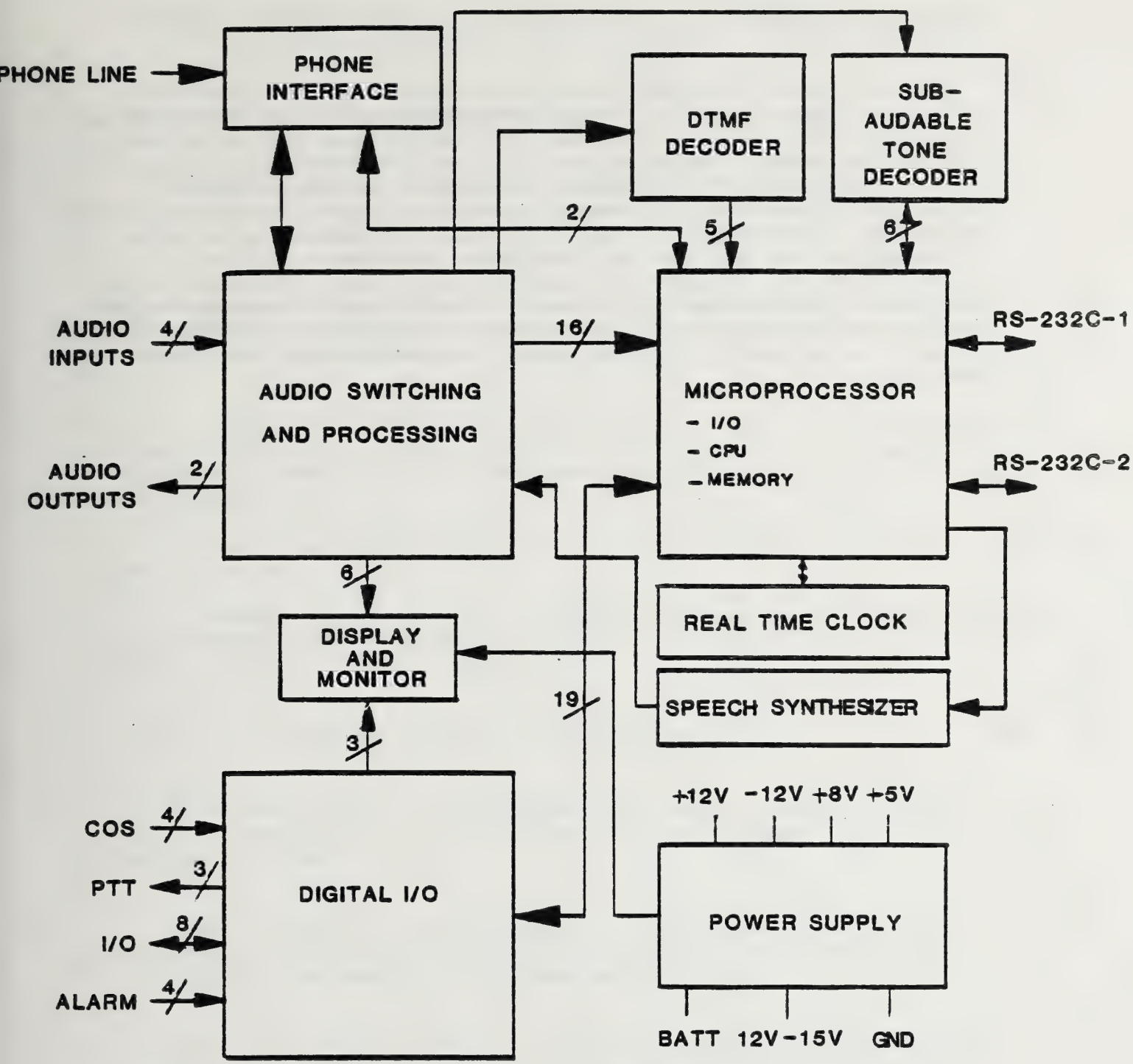
The microprocessor section contains a 4Mhz. microprocessor to control and monitor all analog and digital signals. The controller's firmware (or program) is contained in ROM (read only memory). There is also 16K of RAM (random access memory) available for storing necessary parameters. A real time clock controls all timing of the microprocessor and can also be used for real time control of the repeater or external devices. The microprocessor section receives control data from the DTMF (touch-tone) decoder and the sub-audible tone (PL) decoder. Two RS-232C ports are provided for interfacing to a terminal or printer. A speech synthesizer provides feedback on controller functions to the user.

The analog switching and processing section of the controller provides the audio mixing and switching between receiver, transmitter and remote bases. This section also provides filtering of the audio signal. Also included is an analog delay line. Repeater and remote audio signals are delayed to allow the controller to fully mute touch tones and squelch tail noise from the receiver. This section also contains an audio synthesizer which generates the morse code I.D., courtesy tones, and DTMF tones. Audio is also routed from this section to the phone interface, DTMF decoder, and sub-audible tone decoder.

The digital I/O section interfaces the necessary status signals (COS and PTT) to the receivers and transmitters. It also provides an input/output port and alarm port for interfacing to external devices.

The phone interface is under control of the microprocessor and is used to provide remote control and autopatch capabilities for the controller. The interface meets current F.C.C. part 68 requirements and contains an automatic gain control circuit to keep all levels to the phone line constant.

The display and monitor section allows the user to monitor certain key controller signals. LED's are used as status indicators and an audio monitor is provided to monitor transmit mixer and phone line audio.



R-2000 BLOCK DIAGRAM

Using this manual

Before installing and using your controller for the first time, we suggest that you read up to the section on programming the controller. This will help familiarize yourself with the controller's many features and give you the basics you need to begin with. The other sections deal with the specifics of programming and are not essential for the basic installation and operation of the controller. This material serves as an introduction as well as an invaluable reference aid for programming your R-2000. The appendices contain information on the speech synthesizer vocabulary, the I/O and alarm ports and troubleshooting your controller should any problems occur. Finally, a glossary of terms used is contained at the end of this manual.

INTERFACING THE R-2000 TO YOUR SYSTEM

Care and Handling of the R-2000

The R-2000 has undergone extensive electrical and environmental testing however, some basic precautions should be taken when handling and installing the controller.

- Observe standard CMOS handling precautions. Although all inputs and outputs are protected, avoid exposing the unit to electrostatic discharges.

- The controller should be the first to be powered up and the last thing to be powered down in your system. Avoid applying a voltage to the controller's interface lines with power to the unit off.

- Avoid subjecting the controller to severe mechanical shock or vibration.

- Avoid locating the controller where it will be subjected to extreme heat or direct sunlight.

R-2000 Front Panel Controls and Display

The front panel of the R-2000 includes a status display as well as several controls for monitoring repeater activity. These are as follows:

Power switch - Controls power to the controller. Also functions as the soft reset switch for the controller by turning it off for two seconds and then back on again.

Monitor Volume Control - Controls volume of the internal monitor. Also turns power to the monitor off in the fully counter-clockwise position.

Monitor TX/Phone Switch - Selects the audio source for the monitor, either from the transmit mixer (TX position) or from the phone line only (Phone position).

MIC Input Connector - This jack accepts a microphone for

transmitting local audio from the controller. Can also be used with a touch-tone type microphone for local control of the repeater system.

Status Display - Several L.E.D.'s are provided for indicating the status of key controller signals and functions. These are as follows:

Repeater

RX - Indicates a signal on repeater receive channel.

TX - Indicates controller is re-transmitting received signal.

PL - Indicates a valid sub-audible tone is being decoded by the controller.

Remotes

R1 - Indicates remote #1 activity. Lights continuously in the receive mode and flashes in the transmit mode.

R2 - Indicates remote #2 activity (operation is the same as above).

Autopatch

RI - Phone line ring indicator. Indicates phone line to controller is ringing.

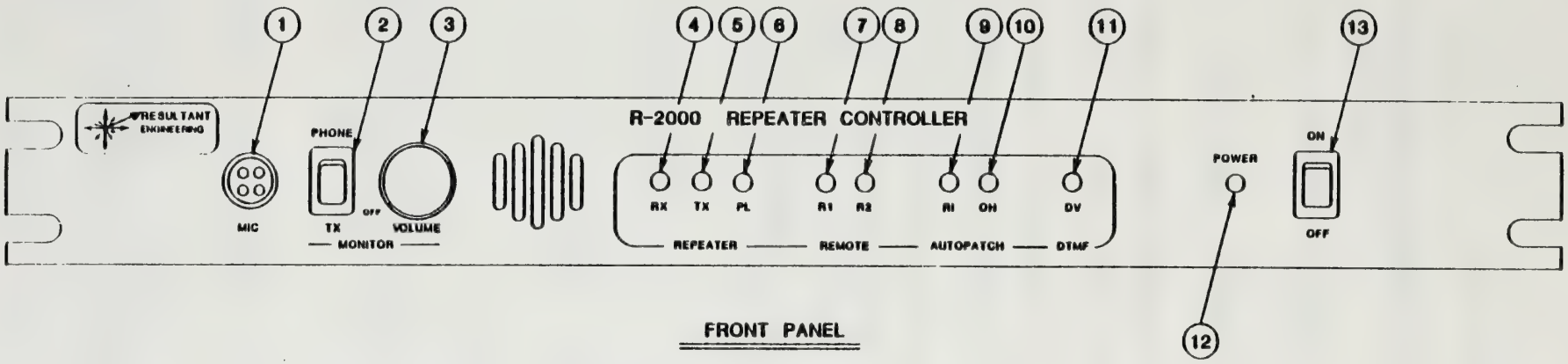
OH - Phone line off hook indicator. Indicates controller has picked up or answered phone line.

DTMF

DV - Data Valid. Indicates valid DTMF (Dual Tone Multi Frequency) tone being received and decoded.

POWER - Indicates Power to controller is on.

An illustration of the R-2000 front panel can be found on the next page.



FRONT PANEL

1 – LOCAL MICROPHONE / CONTROL INPUT
2 – MONITOR PHONE / TX SELECT SWITCH
3 – MONITOR VOLUME
4 – RECEIVE INDICATOR
5 – TRANSMIT INDICATOR
6 – PL DECODE INDICATOR
7 – REMOTE 1 ACTIVITY INDICATOR
8 – REMOTE 2 ACTIVITY INDICATOR
9 – PHONE LINE RING INDICATOR
10 – PHONE LINE OFF HOOK INDICATOR
11 – DTMF DATA VALID INDICATOR
12 – POWER INDICATOR
13 – POWER / RESET SWITCH

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R-2000 Interface Signals

The following connections are provided to interface the R-2000 to your repeater system.

Audio Inputs and Outputs

RPT IN - Audio from repeater receiver.

RMT1 IN - Audio from remote base #1 transceiver (Speaker).

RMT2 IN - Audio from remote base #2 transceiver (Speaker).

CONTROL IN - Audio from control receiver.

RPT OUT - Audio to repeater transmitter.

RMT1 OUT - Audio to remote base #1 transceiver (MIC input).

RMT2 OUT - Audio to remote base #2 transceiver (MIC input).

All audio inputs are high impedance. RPT IN audio gain is adjustable and should be be taken from the discriminator output of the receiver. RMT1 IN and RMT2 IN are designed to be taken directly from the speaker jack of the remote base transceivers. The CONTROL IN input should come from the control receiver and be between .2 - 2 volts R.M.S.. This port is used exclusively for control and will not be heard on the repeater or remote outputs. All outputs are adjustable from approximately 100 mv. to 3 volts. peak to peak.

Phone Line

To utilize the autopatch features of the R-2000, a phone line must be connected to the unit. A modular type phone connector is provided for easy connection to any phone line.

Carrier Operated Switch (COS) Inputs and Push to talk (PTT) Outputs

COS 1 - Carrier operated switch input from repeater receiver.

COS 2 - Optional carrier operated switch input from remote base #1.

COS 3 - Optional carrier operated switch input from remote base #2.

COS 4 - Carrier operated switch input from control receiver.

PTT 1 - Push to talk output to repeater transmitter.

PTT 2 - Push to talk output to remote base #1.

PTT 3 - Push to talk output to remote base #2.

All COS levels are adjustable (threshold between 0 and 5 volts) and can be positive or negative true logic. Push to talk outputs are open collector and can be set for positive or negative true logic also. All COS signals are pre-set for active high inputs and PTT outputs are active low. See the section on programming the controller for more information on how to change these levels. Note that the use of COS 2 and COS 3 is optional. Normally, the VOS signals are used for the remotes, but the COS signals can be used if needed. COS 4 must be grounded if not used. See the section on programming the controller for more information.

User Input/Output Ports

Twelve optional input/output lines are provided for controlling or monitoring external devices. Eight of them can be programmed as input or output lines. They can control devices with T.T.L. level compatible inputs or can be used to provide data for a synthesized remote base transceiver. The other four are level triggered and can be used to initiate certain controller functions upon activation (an alarm routine for instance). See the section on interfacing the R-2000 to other devices for more information.

RS-232C Ports

Two RS-232C ports are provided for interface to a computer, printer, or modem. They will also allow for frequency control of some of the newer transceivers on the market. See the section on programming the controller and interfacing to other devices for more information.

Power/Battery Connectors

The R-2000 requires between twelve and fifteen volts at approximately 600 milliamps for power. In addition, an optional battery input is provided to run the controller in the event of a power failure. The battery voltage should be between 12 and 15 volts. When powered by the main 12 volt supply the battery input also supplies a small trickle charging current to maintain battery voltage. Both the battery and main supplies negative side should be connected to the ground terminal of the controller.

Note: A U.L. approved power supply must be used with this unit in order to comply with FCC part 68 requirements. The transformer must have a minimum winding to winding and winding to core insulation breakdown potential of 1500 volts.

Level Adjustments

Audio levels to the controller can be adjusted via the back panel of the unit. In addition, the sensitivity of the COS and VOS circuits can be adjusted, if needed. The following is a description of each level trimmer and it's function:

Level 1 - Adjusts input gain from repeater receiver.

Level 2 - Adjusts output level to repeater transmitter.

Level 3 - Adjusts output level to remote base #1.

Level 4 - Adjusts output level to remote base #2.

Level 5 - Adjusts trigger threshold of COS 1 (Repeater).

Level 6 - Adjusts trigger threshold of COS 2 (Remote #1).

Level 7 - Adjusts trigger threshold of COS 3 (Remote #2).

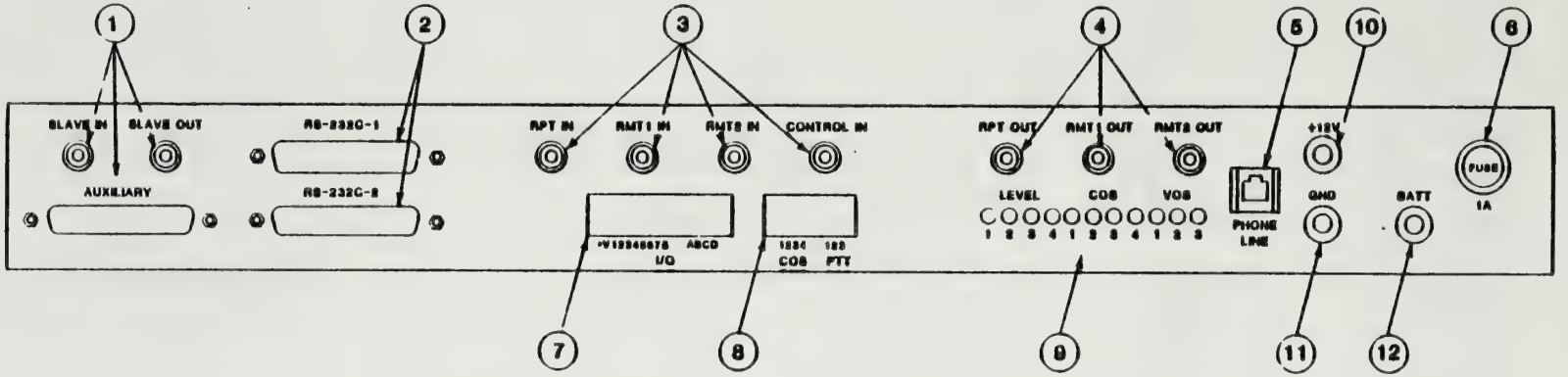
Level 8 - Adjusts trigger threshold of COS 4 (Control RX).

Level 9 - Adjusts sensitivity of VOS 1 (Phone Line).

Level 10 - Adjusts sensitivity of VOS 2 (Remote #1).

Level 11 - Adjusts sensitivity of VOS 3 (Remote #2).

All of the connections and adjustments listed above are accessible via the rear panel of the controller. See the next page for an illustration showing the location of all connectors and trimmers.



REAR PANEL

1 - SLAVE AND AUX PORTS 1 AND 2 (FOR EXPANSION ONLY)
2 - RS-232C PORTS 1 AND 2
3 - AUDIO INPUTS
4 - AUDIO OUTPUTS
5 - PHONE LINE JACK (RJ11C)
6 - FUSE HOLDER
7 - DIGITAL I/O AND ALARM PORT
8 - COS AND PTT PORT
9 - AUDIO,COS, AND VOS LEVEL ADJUST TRIMMERS
10 - +12V POWER INPUT
11 - GND TERMINAL
12 - OPTIONAL BATTERY INPUT

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USING THE R-2000 FOR THE FIRST TIME

It will be assumed in this section that the user has an operational repeater receiver and transmitter along with the appropriate antenna and duplexers. The basic hookup of the R-2000 to the repeater system will be covered and a few functions of the controller will be introduced.

Initial Hookup

A power cable and COS/PTT cable is provided with the controller. The main connections needed to get your R-2000 operational are as follows:

1 - COS 1 from repeater main receiver.

2 - PTT 1 to repeater transmitter.

3 - RPT In audio from repeater receiver discriminator.

4 - RPT Out audio to repeater transmitter.

5 - +12 volts DC power.

All signals are pre-set as follows:

1- COS 1 low 0 - 2 volts D.C. high 2 - 5 volts D.C.

2- PTT 1 Open Collector output - active low

2- RPT IN sensitivity - 1 volt pk-pk

3- RPT OUT level - 1 volt pk-pk

If your P.T.T. signals are not compatible level wise, refer to pages 37 and 38 for examples on programming the level of these signals. Make any audio adjustments as necessary (page explains how to get a 1 kilohertz test tone, if needed).

A phone line should be connected to the R-2000 in order to utilize the autopatch and phone line control capabilities. The other signals need not be connected unless remote bases or a control receiver will be added. See the section on interfacing the R-2000 to other devices for information on the digital I/O lines.

Initial Power On

If you have just purchased the R-2000, the first time it is powered up it will be waiting for the user to enter in the call sign of the repeater system. To hear the controllers responses you must first turn the monitor on and place it in the TX mode. The following is an example of a first time power up sequence.

1 - Power up - controller responds with serial number of unit and message "please enter call sign".

2 - User enters call sign via touch tone pad of radio following specified format (see below).

3 - User enters three stars (***) from keypad to initiate normal repeater operation.

The format for entering the call sign is as follows:

Enter the call sign using the numbers 65 - 91 for letters A - Z and numbers 00 - 09 for numbers 0 - 9 (see page). Separate each character by a pound (#) symbol.

Example: Enter KE6IL as call sign

75 # 69 # 06 # 73 # 76

K E 6 I L

NOTE: Be sure to use the numbers 00 - 09 to represent the numbers 0 - 9. Single digit 0 - 9 entries are invalid.

After the call sign is entered, the user should press three stars in a row. The R-2000 will then start in the normal user level mode. Note that this sequence happens the first time the repeater is turned on and every subsequent time the controller is turned on until a call sign is programmed.

Now that you have programmed the call sign and placed the R-2000 in user level it is ready to operate. All the parameters of the controller (timers, courtesy tones, etc.) have been pre-set

at the factory to default values. These values are as follows:

COS active level - Active high

PTT active level - Active low

Time out timer - 3 minutes

Repeater hang timer - 2 seconds

Remote and VOS 1 hang timer - 0 seconds

Patch timer - 1 minute

C.W. speed - 15 W.P.M.

C.W pitch - 1 Khz.

Courtesy tones - COS 1 - high beep
COS 2 / VOS 1 - low beep
COS 3 / VOS 2 - two low beeps

Courtesy tone delay - .5 seconds

Control Priority - 1) Control receiver 2) Repeater 3) Phone remotes - none

PL Frequency - 100 Hz.

The I.D. and all response to commands will be in voice mode. The section on programming the controller deals with changing these default values as well as many other operating parameters of the controller.

Basic Repeater Operation

Now that you have set the necessary parameters and a suitable receiver and transmitter have been connected to the R-

2000, the repeater system is ready to use. Being in the user mode, it is also ready to accept commands from your touch tone radio. Although these will not be discussed in detail right now, a few examples are given so you can become familiar with how to enter a basic command. Key down your radio on the repeater input and enter a '125#1'. The repeater will respond with the word "one". You have just executed the keypad test command. Any group of numbers after '125#' will be echoed back by the controller. Now enter '121' from the keypad. The controller will respond with the call sign that it is programmed with. If a phone line is connected to the R-2000, enter 101#7671234 from the keypad. The controller will dial time automatically. Enter 106 to hang up the patch. These have been a few examples of some of the capabilities of the R-2000. The next few sections describe in detail all of the functions and capabilities of the R-2000.

R-2000 CODES AND FUNCTIONS

The R-2000 has two different levels of operation. The first and most frequently used is the user level. This level allows the repeater to be used for voice communication and provides the user touch-tone access to all the user level functions of the controller. Control operator functions can also be accessed from the user level, but an optional password can be programmed to limit access to these codes.

The other level of operation is the program control level (P.C.L.) which is accessed by entering in a password code. This level allows the operating parameters of the controller to be programmed and modified as needed. It also allows access to diagnostic and self test features of the controller. The following sections describe the different levels of the controller a well as the codes and how to execute them.

R-2000 Command Structure

The R-2000 is designed to take commands from a touch-tone phone or via a radio touch-tone pad. It will accept all 16 standard DTMF tones. The controller can auto-answer the phone line and then be accessed or programmed from the phone. The controller can also accept commands from any of the receivers that are interfaced to it. If the optional local microphone is equipped with a touch-tone pad, this can also be used for local control of the R-2000. To enter the command after a string of numbers has been pressed the user needs to merely unkey the radio or press two pounds (##) from the phone. A pound can also be entered between codes from the radio to cause execution of the command before the key is dropped. All commands have a numerical code assigned to them. These codes are all factory defined but the user can change any of the user level codes to any 1-9 digit code. The execution of the code will be acknowledged by the voice synthesizer in the voice mode and a morse character in the C.W. mode. Most codes execute immediately after being entered while others require data or a selection to be made. These commands can be entered two ways. The first is to enter the first part of the code in which case the controller will prompt you for the next entry. The other is to enter the command and the data in a string, separating them with a pound (#) character. Codes can also be entered in a string over the phone by separating the command and data with pounds. The following examples will use the ` ^ ' symbol as the 'enter' character and indicates that either a pound symbol can be used or that the transceiver can be unkeyed between entries.

User Level Codes

The user level codes are those that can be accessed while the controller is in the user level. The following is a list of all user level codes (user and control) followed by a description of each code and an example of how it is entered.

Code #	Code Function	Entry Format
	USER CODES	
1.	Autopatch connect	101^
2.	Duplex patch connect	102^
3.	Patch connect (predial)	103^
4.	Duplex patch connect (predial)	104^
5.	Patch timer reset	105^
6.	Patch cancel	106^
7.	Last number redial	<Patch Connect Code>^*^
8.	Toll restrict disable	108^
9.	Patch audio mute	109^ (during call)
10.	Reverse patch	110^
11.	Reverse patch answer	111^
12.	Remote base monitor	112^
13.	Remote base transceive	113^
14.	Remote base frequency	114^(frequency)^(1-3)
15.	Remote base status	115^
16.	Remote base off	116^
17.	Mailbox 1. Check mail 2. Read mail 3. Send mail 4. Erase mail	117^(1-4)
18.	Phone monitor mode on	118^
19.	Phone monitor mode off	119^
20.	Phone transceive mode on	120^
21.	Phone transceive mode off	121^
22.	Forced I.D. message	122^
23.	Say time and date	123^
24.	Say message n	124^(message number)
25.	Say bulletin board message	125^
26.	Keypad test	126^
27.	DTMF unmute	127^
28.	Touch tone access	128^
	CONTROL OPERATOR CODES	
29.	Repeater enable/disable	129^(0 or 1)

Code #	Function	Entry Format
30.	Set P.L. mode 1. P.L. for general access 2. P.L. for all codes 3. P.L. for control and P.C.L. codes 4. P.L. for P.C.L. codes 5. P.L. access table 6. P.L. off	130^(1-6)
31.	User code n enable/disable	131^(user code #)^(0 or 1)
32.	Noise filter on/off	132^(0 or 1)
33.	Touch tone access on/off	133^(0 or 1)
34.	I/O line n on/off	134^(line number)^(0 or 1)
35.	I/O line n status	135^(line number)
36.	Alarm arm/disarm	136^(1-4)^(0 or 1)
37.	Alarm reset	137^
38.	Alarm switch test	138^
39.	Phone # readback on/off	139^(0 or 1)
40.	Execute macro n	140^(macro number)
41.	Call configuration n	141^(configuration number)
42.	Toll restrict on/off	141^(0 or 1)
43.	Global toll restricts on/off	142^(0 or 1)

Description of User level codes

The following section gives a description of each user level code as well as an example of how each code is entered. All codes entered by the user are placed in brackets (< >). The ^ symbol indicates either a key drop or a pound (#) entry. Any data required after the command will be indicated by the letter 'n" indicating a numerical value, or in parenthesis, indicating a specific input parameter.

USER CODES

1. Autopatch connect - This code allows the user access to the R-2000's autopatch. The code can be entered by itself only for the manual dial mode, or a string can be entered to allow access to autodial locations. The controller can be programmed with phone numbers for autodial use (see P.C.L.codes).

Format: <101>^(phone number or memory location)

Example: Dial number manually

1. Enter <101>^
2. Controller responds with "please dial"
3. Dial phone number from keypad

Autodial 555-1234

1. <101>^5551234
2. controller dials number automatically

Autodial phone number in memory location 20

1. <101>^20
2. Controller dials number in memory location 20

In all cases, when the patch is activated, call progress detection will attempt to pull the phone line off hook and get a dial tone. If no dial tone is present, the controller will hang up and respond with "try again". This message may indicate a bad phone line or faulty connection to the phone line. If the controller gets a dial tone, it will autodial the number and check the line again. If the number is busy, the controller will respond with "busy - try again" and the patch will be hung up. The patch connect code will automatically disable the remotes for the duration of the call unless the code was actually entered from one of the remotes. When this is done the patch will function as a VOS controlled simplex patch from the remotes.

2. Duplex patch connect - This code functions exactly as the patch connect code except the audio path will be full duplex. If the duplex code is executed with a remote activated then the user can monitor the caller on the repeater or the remotes.

3. Patch connect (predial) - This code functions as does the patch connect but will dial a one to three digit number for accessing a PBX outside line before the phone number is dialed.

4. Duplex patch connect (predial) - This code is a duplex version of the previous code for PBX outside line access.

5. Patch timer reset - This code is used to reset the autopatch time out timer. The timer is normally set to 1 min. and can be programmed for any duration. Ten seconds before the timer drops the patch, a warning tone will be sent by the controller. Executing the reset patch timer code and resets the counter to zero and allow the user to continue the call.

6. Patch cancel - The patch cancel code will automatically terminate a call and return the controller to normal operation.

7. Last number redial - Any number dialed either automatically or from memory is stored in a buffer and can be automatically redialed. The user merely enters the patch connect code followed by a pound and a star (*). The controller will then dial the last number called.

8. Toll restrict disable - This code allows a calling party to make a one time long distance call from the controller if the toll restricts are enabled. The toll restricts are automatically enabled again when the call is terminated.

9. Patch audio mute - This code can be executed only during a call and will mute the user's audio while still transmitting the phone side of the conversation. This provides a semi-private patch mode.

10. Reverse patch - This code can be executed only from the phone line after the controller has answered. It will alert those on the repeater frequency that someone is waiting to talk over the patch. Two modes of entry are possible, one for a general reverse patch and another to page a specific user (see the section on multi-user capabilities for more information).

Format: <110>^(optional user number)

Example: Initiate a reverse patch after the controller has answered.

1. <110>

2. Controller will announce reverse patch over the air and generate ringing tone.

Initiate a reverse patch to user 20

1. <110>^20

2. Controller will page specific user by call sign and generate ringing tone.

The controller will automatically terminate the reverse patch if not answered within one minute after the reverse patch was initiated.

11. Reverse patch answer - This code can be executed from the radio only during a reverse patch. It will place the calling party on the repeater system.

12. Remote base monitor - Allows the user to monitor the receive frequency of the remote bases. Note that this code requires that the number of the remote (1 or 2) be entered after the code itself.

Format: <112>^(Remote base number)

Example: Monitor remote base number 2

<112>^2

13. Remote base transceive - Executing this code places the remotes in the full transceive mode.

Format: <113>^(Remote base number)

Example: Transceive on remote base number 1

<113>^1

14. Remote base frequency - This code will send frequency data to the remote bases. The code is executed followed by the remote base number (1 or 2), the frequency in megahertz (a star is used as a decimal point), and a 1, 2, or 3 for simplex, duplex (- offset), or duplex (+ offset). The user can also program the remote frequency from a memory channel by entering the channel number after the code. See the section on programming the controller for information on frequency control ports and the remote base memory channels.

Format: <114>^(remote base number)^(frequency or memory channel)

Example: Set remote 1 for 146.52 simplex

1. <114>^1^146*52^1

2. Controller responds with "remote 1 146 point 52 megahertz"

Set remote 2 for memory channel 14

1. <114>^2^14

2. Controller responds with channel number and frequency

See the section on interfacing the R-2000 to external devices for more information on frequency control of remote bases.

15. Remote base status - This code allows the user to check the status of the remotes. The controller will announce whether a remote is on and, if so, what frequency it is set for.

16. Remote base off - This code turns off the remote base function.

17. User mailbox - This code allows a user to send and receive messages. The user can check mail, read mail or send mail. The messages available consist of ten preset ones and up to 10 custom messages. See the section on programming the controller for configuring users and adding new messages. Note that the code for the mailbox is unique to each user and must be programmed under the program and control level. These examples assume that the user was assigned 117 as his mailbox code.

Format: <117>^(1-4)^(user number)^(message)

1 - Check Mail
2 - Read Mail
3 - Send Mail
4 - Erase mail

Example: Check Mail

1. <117>^1

2. Controller responds with either "no messages" or "you have messages"

Read mail

1. <117>^2

2. Controller reads back any messages stored

Send Mail

1. <117>^3^<User #>^<message #>

2. controller reads back message and user number to verify

Erase Mail

1. <117>^4

2. All mail will be erased

Notice that the send mail code requires that the number of the user that the message will be sent to be entered in as well. The following is a list of the ten standard messages.

Message #	Message
1	Please call me at home
2	Call me at work
3	Call me on the repeater
4	Will call again
5	Returning your call
6	Waiting for your call
7	Called to say hello
8	Wants to see you
9	Will be home later
10	Emergency, please call

18. Phone monitor mode on - This code can be executed from the phone only and allows the calling party to monitor the repeater audio from the phone line. The monitor function can be turned off with the phone monitor off code or will be terminated when the caller hangs up.

19. Phone monitor mode off - Turns off the phone monitor function.

20. Phone transceive mode on - This code can be executed from the phone only and allows the user to transmit over the repeater system from the telephone. It is VOS activated and will transmit only when the user speaks into the phone. This code is also turned off when the phone is hung up or can be turned off using the "phone transceive off" user code.

21. Phone transceive mode off - This code will turn off the phone transceive mode function.

22. Forced I.D. - This code will cause the controller to say the I.D. sequence that it has been programmed for.

23. Say time and date - Announces the current time and date.

24. Say message n - This code allows the user to hear both the standard messages as well as the custom programmed ones.

Format: <124>^(message number)

Example: Say message number 6

<124>^6

Controller responds with message 6

25. Say bulletin board message - This code allows the user to listen to the system bulletin board message, This is usually programmed with messages of interest to users by the system owner.

26. Keypad test - This code allows the user to check the touch-tone keypad on his radio or phone if a bad digit is suspected. The controller will echo back any string of digits entered after the code.

Format: <126>^(string of digits)

Example: Test tones 1, 2 and 3 on keypad

<126>^123

Controller responds with "one, two, three".

27. DTMF unmute - This code turns off the touch-tone muting feature of the R-2000 so control tones can be sent over the repeater to other controllers or touch tone control devices. The mute feature will automatically be enabled on the next transmission.

28. Touch-tone access code - This code allows the user to bring up the repeater when in the touch-tone secured mode. The repeater can be placed in the touch-tone secure mode by the control operator. See the P.C.L. code for programming the access code for more information.

Control Operator Codes

The control operator codes can be accessed from user level however, they may need a special password to activate them. This can be programmed in if the owner wishes. The entry format for the control codes is the same as for user codes. All control operator codes relate to the control of the repeater system.

29. Repeater enable/disable - This code will shut down or bring up the repeater system when executed. A 0 or 1 is entered after the code for off or on.

Format: <129>^(0 or 1, 0=off 1=on)

Example: Disable repeater

<129>^0

controller responds with "repeater disabled"

Enable repeater

<129>^1

controller responds with "repeater enabled"

30. Set P.L. mode - This code sets up the P.L. access requirements for the system. Six separate modes for repeater or code security are available . The section on programming the

controller describes how to program the frequency of the decoder. The different modes available are as follows:

Mode 1 - Turns off the P.L. decode function.

Mode 2 - Repeater requires P.L. for general access.

Mode 3 - Repeater requires P.L. for code entry only.

Mode 4 - Repeater requires P.L. for control or P.C.L. code entry only.

Mode 5 - Repeater requires P.L. for P.C.L. code entry only.

Mode 6 - Controller uses P.L. table to check which codes need P.L. for execution. See the section on programming the controller for information on how to set up this table.

Format: <130>^(mode 1 - 6)

Example: Put controller in P.L. mode 1

<130>^1

31. User code n enable/disable - This code allows the control operator to selectively enable or disable user codes 1-28. The code is entered followed by the number of the code you wish to enable or disable and a 0 or 1. Note that this number is obtained from the user code list and is not the code itself. If a 0 is entered after the code, all user codes can be enabled or disabled.

Format: <131>^<user code number>^(0 or 1, 0=disable 1=enable)

Example: Disable User code 9

<131>^9^0

32. Noise Filter on/off - This code allows the control operator to turn the noise filter on or off. This feature prevents sporadic noise or signals from bringing up the repeater system.

Format: <132>^(0 or 1, o=off 1=on)

Example : Turn noise filter on

<132>^1

33. Touch-tone access on/off - This code allows the control operator to put the repeater in a touch-tone secure mode. Any transmission to be made on the controller needs to be preceded by a touch-tone access code by the user. This access code is programmed using the proper P.C.L. code.

Format: <133>^(0 or 1, 0=off 1=on)

Example: Turn on touch tone secure mode

<133>^1

34. I/O line n on/off - This code allows the control operator to activate the I/O lines 1 - 8 to control external devices. The lines can be turned either on or off with this command. See the sections on programming the controller and interfacing to external devices for more information on using these ports.

Format: <134>^<line number>^(0 or 1, 0=off 1=on)

Example: Turn I/O line 4 on

<134>^4^1

35. I/O line n status - This allows the status of the I/O port to be checked by the control operator. If the line is configured as an input it will read the line and give the user the level.

Format: <135>^(line number)

Example: Check status of line number 7

<135>^7

36. Alarm arm/disarm - Arms or disarms the system alarm lines which can be used for shack security or to initiate certain controller functions. See the section on interfacing to external devices for information on the alarm lines. The code is entered followed by the code number and 0 or 1 for disarm or alarm.

Format: <136>^(1-4)^(0 or 1, 0=disarm 1= arm)

1 - Alarm line A
2 - Alarm line B
3 - Alarm line C
4 - Alarm line D

Example: Arm system alarm

<136>^1

37. Alarm reset - This code will reset the alarm in the event that it was activated. The alarm reset code only resets two types of alarm events. See the section on the alarm macros for more information.

38. Alarm switch test - This code allows the control operator to check the condition of the four alarm inputs to the controller. Executing the code causes the controller to read back the current status of each of the lines.

39. Phone number readback on/off - This code allows the autopatch phone number readback feature of the controller to be turned on or off. This feature will announce the phone number before it is dialed during an autopatch call.

Format: <139>^(0 or 1, 0=off 1=on)

Example: Turn phone number readback off

<139>^0

40. Execute macro n - This code allows a macro to be called up by the control operator. See the sections on programming and customizing your repeater system for more information about macros. The code is entered followed by the number of the macro that you want to execute.

Format: <140>^(macro number)

Example: Call macro number 4

<140>^4

41. Call configuration n - This code allows the control operator to call one of the configurations programmed (see the P.C.L.

codes for more information. The code is entered followed by the configuration number.

Format: <410>^(configuration number)

Example: Call configuration number 3

<410>^3

42. Toll restricts on/off - This allows the toll restrict function to be turned on or off. The toll restrict tables can be programmed to restrict long distance, toll calls, and select numbers. See the section on programming the controller for more information. This code will not affect the user toll restricts.

Format: <141>^(0 or 1, 0=off 1=on)

Example: Turn toll restricts off

<141>^0

43. Global Toll restricts On/Off - This code allows the system as well as user toll restricts to be turned on and off. This code will restrict all long distance when enabled.

Format: <142>^(0 or 1, 0=off 1=on)

Example: Turn global toll restricts off

<142>^0

PROGRAMMING THE R-2000

Program Control level

This is the second level of operation that allows the repeater owner to reprogram virtually all the operating parameters of the controller. All timers, courtesy tones, I.D. messages and other features can be customized to suit the users needs. In addition, this level also allows access to the time/calendar functions and logging tables. The P.C.L. codes also contain several diagnostic commands to aid you in setting up and testing your controller. This level is accessed by means of the P.C.L. code that was assigned to your particular unit (this is listed in the letter of information which you received with the R-2000). This code is an eight digit random code but another short access code can also be programmed if needed. All of the codes have the same format as the user codes discussed previously. The controller will prompt the user for an input when the controller is in the voice mode and a P.C.L. code is entered. To exit P.C.L. after programming any parameters the user needs to enter three stars (***) from the keyboard. This will place the R-2000 back in user level with the new parameters just programmed.

List of P.C.L. Codes

The following is a list of each P.C.L. code as well as an example of how each one is entered.

Code #	Function	Entry Format
1.	Program call sign	010^(call sign string)
2.	Set C.W. pitch	020^(frequency in hertz)
3.	Set C.W. speed	030^(5-25)
4.	Set time and date	040^MMDDYYYY(day 1-7)HHMMSSnn
5.	Enter COS active level	050^nnnn
6.	Enter PTT active level	060^nnn
7.	Enter Rmt. configuration	070^(remote number)^(0 or 1)
8.	Enter control priority	080^nnnnn 1=lowest 5=highest 0=none
9.	Set timer 1-10	090^(1-10)^HHMMSS*SS
	1. COS 1 hang time	
	2. COS 2/VOS 1 hang time	
	3. COS 3/VOS 2 hang time	
	4. VOS 3 hang time	
	5. COS 1 time out	
	6. COS 2/VOS 1 time out	
	7. COS 3/VOS 2 time out	

Code #	Function	Entry Format
	8. VOS 3 time out	
	9. Courtesy tone delay	
	10. Patch time out timer	
10.	Set courtesy tone n	100^(COS #)^(tone string)
11.	Set courtesy tone speed	110^(COS #)^(1-10)
12.	Set I.D./tone volume	120^(1-10)
13	C.W. mode on/off	130^(0 or 1)
14.	Program C.W./voice	140^(code #)^(0 or 1)
15.	Program new user code	150^(code #)^(new code)
16.	Program control password	160^(password)
17.	Program user access code	170^(access code)
18.	Add P.C.L. access code	180^(new code)
19.	Program sub-audible freq.	190^(frequency)
20.	Program P.L. access table	200^(code#)^(0 or 1)
21.	Enter custom message	210^(message string)
22.	Program toll restricts	220^(1-2)^(1-3)^(number)
23.	Select toll restricts	230^nnnnn
24.	Set dialer mode	240^(1-3)
	1. pulse dial 10 pps	
	2. pulse dial 20 pps	
	3. DTMF tone dial	
25.	Program autodial location	250^(1-3)^(location)^(phone #)
	1. Add number	
	2. Erase number	
	3. read number	
26.	Set autodial memory size	260^(memory size)
27.	Program patch predial #	270^(number)
28.	Store macro nn	280^nn^(code string)
29.	Program alarm A-D macro	290^(1-4)^(code string)
30.	Store configuration	300^(configuration #)
31.	List configuration	310^(1-3)
	1. List parameters	
	2. List codes	
	3. List codes and parameters	
32.	Set timer event	320^(event)^HHMMSSMMDDYYYY^(code #)
33.	Add user	330^(user number)^(1-8)
	1. Program Call sign	
	2. Select toll restricts	
	3. Program mailbox code	
	4. Program reverse patch code	
	5. Program autopatch connect code	
	6. Program autopatch connect code (predial)	
	7. Program duplex patch code	
	8. Program duplex patch code (predial)	
34.	Program time out message	340^(message string)
35.	Program reset message	350^(message string)
36.	Program answer message	360^(message string)
37.	Program answer ring #	370^nn
38.	Program tail message n	380^(COS #)^(message string)
39.	Program bulletin board	390^(message string)
40.	Enable/Disable call log	400^(0 or 1)

Code #	Function	Entry Format
41.	Clear call log	410^
42.	Read call log	420^(1 or 2)
	1. All users	
	2. Select users	
43.	Dump Call Log to RS-232	430^(1-2)
	1. All users	
	2. Select users	
44.	Enable/Disable rpt log	440^(0 or 1)
45.	Clear repeater log	450^
46.	Read Repeater Log	460^(1 or 2)
	1. All users	
	2. Select user	
47.	Dump RPT log to RS-232	470^(1-2)
	1. All users	
	2. Select user	
48.	Program remote freq. port	480^(Rmt#)^(1-4)
	1. BCD 1	
	2. BCD 2	
	3. RS-232-1 (Kenwood format)	
	4. RS-232-1 (Kenwood format)	
49.	Program rmt mem. channels	490^(Rmt. #)^(channel#)^(frequency)
50.	Configure I/O port	500^(port #)^(1-5)
51.	Configure alarm port	510^(line number)^(0 or 1)
52.	Configure RS-232C port	520^(bd. rate)^(bits)^(1-3)

R-2000 REMOTE DIAGNOSTIC COMMANDS

1.	ROM checksum	610^
2.	RAM checksum	620^
3.	RS-232 diagnostics	630^
4.	Audio test tone on/off	640^(0 or 1, 0=off 1=on)
5.	COS test on/off	650^(0 or 1, 0=off 1=on)
6.	System hard reset	660^(0 or 1)^**

Description of P.C.L. Codes

The following is a description of all P.C.L. codes as well as examples of how they are entered. The format is generally the same as the user level codes except that most P.C.L. codes require data to be entered after the code itself.

1. Program call sign - This code allows the owner to set the system call sign used for identification purposes. The call sign is programmed by entering a string of numbers and letters.

Format: <010>^(Letter and number string)

All numbers 0 - 9 are represented by the characters 00-09. All letters are entered as numbers starting at 65 as listed below:

A - 65	G - 71	M - 77	S - 83	Y - 89
B - 66	H - 72	N - 78	T - 84	Z - 90
C - 67	I - 73	O - 79	U - 85	/ - 720
D - 68	J - 74	P - 80	V - 86	
E - 69	K - 75	Q - 81	W - 87	Space - 721
F - 70	L - 76	R - 82	X - 88	

Note: the slash is commonly used after the call sign and before the R suffix for repeater identification.

Format: <010>^(I.D. string)

Example: Enter KE6IL/R as call sign.

<010>^75^69^06^73^76^91^82^

Note that the "/R" will be ignored when a voice I.D. is made. Also note that any word from the R-2000 vocabulary list can be programmed along with the letters and numbers for the call sign. See the section on customizing your repeater for more information.

2. Set C.W. pitch - Sets the pitch of the C.W. messages sent by the R-2000. The pitch of the C.W. generator is entered directly in hertz and can range from 200 Hz. to 3000 hz..

Format: <020>^(frequency in hertz)

Example: Set C.W. Pitch to 1000 hz.

<020>^1000

3. Set C.W. speed - This code will set the speed of the C.W. sent by the controller. The speed is entered in words per minute and can be varied from 5 to 25 w.p.m..

Format: <030>^(speed in W.P.M.)

Example: Set C.W. speed to 18 words per minute

<030>^18

4. Set time and date - This code allows the owner to set the R-2000's real time clock. The clock/ calendar keeps track of hours, minutes and seconds as well as the year, month, date, and day of week.

Format: <040>^MMDDYYYY(day 1-7)HHMMSSnn

MM - month 01 - 12
DD - date 01 - 31
YYYY - calendar year
day 1 - 7 - day of week (Monday=1 Sunday=7)
HH - hour of day (12 hour format)
MM - minutes
SS - seconds
nn - first n - 0=am 1=pm
second n - 0=12 hr. time 1=24 hr. time

Example: Set Clock/Calendar to Tuesday May 10,1986 at 11:30 a.m , 12hr.format

<040>^05 10 1986 2 11 30 00 00

Note: the numbers in the example were separated for clarity.

After the time is entered, a star (*) needs to be entered to set the clock.

5. Enter COS active level - This command allows the active (or true) level of COS 1 - 4 to be set. The four variables entered after the code represent COS 1 - 4 respectfully. A 0 or 1 is entered in each position to indicate active high or low.

Format: <050>^nnnn

nnnn = COS 1 - 4

Example: Set COS 1 and 2 for active high and COS 3 and 4 for active low.

<050>^1100

Set COS 1,2,and 3 for active high and COS 4 for active low.

<050>^1110

6. Enter P.T.T. active level - This code allows the active level of PTT 1 - 3 to be set. The code is entered the same way as the set COS command.

Format: <060>^nnn

nnn= PTT 1 - 3

Example: Set PTT 1 for active low and PTT 2 and 3 for active high.

<060)^011

Set PTT 1 and 2 for active high and PTT 3 for active low.

<060>^110

7. Enter remote configuration - This code allows the owner to specify to the controller whether or not COS signals will be used for the remotes. The controller normally uses the VOS signals generated internally to detect a received signal from the remotes. Using this P.C.L. code, the user can specify that the COS ports will be used. The code is entered followed by the remote number and a 0 for VOS or a 1 for COS.

Format: <070>^(remote number)^(0 or 1, 0=VOS 1=COS)

Example: Configure remote base 1 for COS operation

<070>^1^1

Configure remote base 2 for VOS operation

<070>^2^0

8. Enter control priority - This code allows the owner to enter the DTMF control priority of all audio inputs. This will allow the controller to choose the input to decode when more than one source of DTMF tones is present. The variables nnnnn represent the control receiver, repeater, remote 1, remote 2, or phone line respectively. A value from 1 to 5 can be entered in any position indicating the control priority of that device. If a

0 is entered for any of the devices touch-tone control will be disabled from that channel.

Format: <080>^nnnnn

nnnnn = control receiver,repeater, phone, remote 1, remote 2

Example: Enter Control receiver as first priority, repeater second,phone line third, remote 1 fourth, and remote 2 fifth.

<080>^12345

Enter control receiver as first priority, repeater second, phone line third, and no control from remote 1 and 2.

<080>^12300

9. Set timer 1 - 10 - This code is used to set the value of the timers on the R-2000. The code is entered followed by the timer number and then the value in minutes, seconds, tenths of seconds and hundreds of seconds. The ten system timers of the R-2000 are as follows:

1. COS 1 hang time - sets hang time of repeater channel.
2. COS 2/VOS 2 hang time - sets hang time for remote 1.
3. COS 3/VOS 3 hang time - sets hang time for remote 2.
4. VOS 1 hang time - Sets hang time of VOS 1 for phone transceive and simplex remote patch functions.
5. COS 1 time out - sets maximum length of transmission on repeater channel.
6. COS 2/VOS 2 time out - sets maximum length of transmission for remote 1.
7. COS 3/VOS 3 time out - sets maximum length of transmission for remote 2.
8. VOS 1 time out - sets maximum length of transmission for phone transceive and simplex remote patch functions.
9. Courtesy tone delay - sets delay between end of received transmission and courtesy tone.
10. Patch time out timer - Sets maximum length of auto patch calls.

Format: <090>^(timer number)^(timer value in seconds)

Example: Set patch time out timer to 1 minute

<090>^10^0100^

Set repeater hang time to .5 seconds

<090>^1^00*50

10. Set courtesy tone n - This code allows the owner to set a courtesy tone for any input. The variable n indicates which courtesy tone to set. The tones can be entered singly or in any combination to produce multiple tone courtesy tones. Up to 10 tones may be entered in a string. The frequency of the tone is entered directly in hertz and can be from 200 hertz to 3000 hz.. A zero can be entered to place silence between multiple tones. The length of each tone or silence duration is determined by the courtesy tone speed setting. Many different and interesting courtesy tones can be programmed using this code and the courtesy tone speed code.

Format: <100>^(1 - 4)^(tone string)

1 - COS 1
2 - COS 2/VOS 2
3 - COS 3/VOS 3
4 - VOS 1

Example: Enter single 1 khz. tone for COS 1 courtesy tone.

<100>^1^1000

Enter multiple tones for COS 2 courtesy tone.

<100>^2^10^20^15

11. Set courtesy tone speed - This code allows the speed (or duration in the case of single tones) of the courtesy tone to be set. The speed can be set for any value between 1 and 10. The length of each tone or silence duration is 1 second at 10.

Format: <110>^(COS number)^(1-10)

Example: Set courtesy tone for COS 1 speed to 5

<110>^5^

12. Set I.D./tone volume - The volume of the C.W. messages and the courtesy tones can be set with this command.

Format: <120>^(1-10)

Example: Set volume to 8

<120>^8

13. C.W. mode on/off - This code puts the controller in the C.W. mode with no voice synthesizer messages. All responses to codes will be acknowledged with a morse code "R" from the controller. The I.D. messages will also be in C.W.. Where variables such as time, frequency, etc. are part of the message, they will be sent in morse code.

Format: <130>^(0 or 1, 0=off 1=on)

Example: Turn C.W. mode On

<130>^1

Turn C.W. Mode Off

<130>^0

14. Program C.W./voice - This code allows selection of voice or C.W. messages for the individual user codes. This will allow the system to have voice messages only on select functions. The code is entered followed by the user code number and then a 0 or 1 for C.W. or voice.

Format: <140>^(User Code number^(0 or 1)

Example: Set User code 1 for voice feedback and User code 14 for C.W..

<140>^1^1

<140>^14^0

15. Program new user code - This code allows reprogramming any of the user access codes to the controller. The new codes can be defined as any 1 - 9 character string (with the exception of the pound sign which should never be used to define any other code

except for "patch cancel"). The code is followed by the user code number (see list) and then the new value of the code.

Format: <150>^(code number)^(new code value)

Example: Change autopatch access code to *15

<150>^1^*15

16. Program control password - This code allows a control password to be programmed. This will need to be entered by the control operator before executing any control code. The password will be required to enter a control code again each time the key drops or two pounds are pressed on the phone.

Format: <160>^(password)

Example: Enter 324 as control password.

<160>^324

If the code is executed and no password is entered after it, the control codes can be accessed without a password.

17. Program user access code - This code allows the user access code (for use when in the touch tone secure mode) to be programmed. The code can be any 1 to 9 digit number.

Format: <170>^(code)

Example: Set user access code to 15

<170>^15

18. Add P.C.L. access code - This code allows the owner to define a new P.C.L. access code. This code will work in addition to the factory set code. This prevents the code from being forgotten or from accidentally being changed. It is recommended that, in order to protect keep the original code from being recorded or decoded by unauthorized persons, that the code be changed upon receipt of the R-2000. This can be done over the air or over the phone for added security.

Format: <180>^(new P.C.L. access code)

Example: Add 136 as new P.C.L. access code

<180>^136

19. Program sub-audible tone decoder frequency - This code allows programming the R-2000's sub-audible tone decoder frequency. The frequency is entered in hertz.

Format: <190>^(frequency in hertz)

Example: Set decoder frequency to 100 hertz

<190>^100

20. Program P.L. access table - This table allows the owner to indicate whether not a sub-audible tone will be required for access to specific user codes. This will allow the system to have certain codes which are accessible only to select users with PL encoders installed in their radios.

Format: <200>^(user code number)^(0 or 1, 0=No P.L. 1=P.L.)

Example: Program User code 1 to require PL

<200>^1^1

21. Enter custom message - This code allows the owner to program custom messages for the user mailbox. These messages can also be activated by using the "say message n" code. The custom messages begin at location 11. The words are entered from the R-2000 vocabulary list (see appendix I). Notice also that silence durations need to be added. These are labeled as 'sil' followed buy the value in milliseconds.

Format: <210>^(location 11-20)^(Message String)

Example: Enter "R-2000 repeater controller" as message 11.

<210>^83^715^711^29^715^441^714^143^612

22. Program toll restrict tables - This code allows the toll restrict tables to be programed. The three separate tables which can be selected are, 1) the area code table, 2) the local prefix lockout table, and 3) the number lockout table. The area code table tells the controller which area codes are allowed to be

dialed. The prefix and number lockout tables actually restrict the numbers entered in them.

Format: <220>^(Table number)^(1 - 2)^(number)

1 - Add Number
2 - Delete Number

Tables:

1 - area code
2 - prefix restrict
3 - number restrict

Example: Enter 415 in area code table.

<220>^1^1^415

Enter 732-9482 in number restrict table.

<220>^1^3^7329482

Delete 415 from area code table.

<220>^2^3^415

23. Select toll restricts - The toll restrict select feature allows the owner to prevent to select the type of long distance or toll calls to restrict from being made through the autopatch. The controller can be programmed to reject numbers with greater than seven digits, with a leading one or zero, or specific prefixes or numbers from the toll restrict tables. The code is entered followed by a string of ones or zeros to enable or disable each toll restrict selection.

Format: <230>^nnnnn

nnnnn = greater than 7 digit, leading 0 or 1, area code, prefix lockout, number lockout.

Example: Select leading 1 or 0, area code, and number lockout toll restricts.

<230>^01101

Select greater than 7 digit and number lockout toll restricts.

<230>^10001

24. Set dialer mode - This code sets the autopatch dialer mode. Either pulse or DTMF dialing modes can be selected. The dialer should normally be set for DTMF dialing unless you are located in an area with no touch-tone service.

Format: <240>^(1 - 3)

1 - pulse dial, ten pulses per second
2 - pulse dial, twenty pulses per second
3 - DTMF dial

Example: Set dialer for DTMF dialing

<240>^3

25. Program autodial location - This code allows the autodialer memory locations to be programmed. The locations can be loaded, cleared, and read. The code is entered followed by the location, selection (add, clear, or read), and the number.

Format: <250>^(location)^(1-3)^(Phone number)

1 - Add number
2 - Clear number
3 - Read number

Example: Add 732-9482 to location 1

<250>^1^1^7329482

Add (415) 555 1312 to location 2

<250>^1^1^4155551312

Clear 732-9482 from location 1

<250>^1^2

26. Set autodialer memory size - This code allows the memory size of the autodialer to be defined. The owner should make the memory size big enough to hold the amount of numbers he has in it. This

will save more memory for other functions which need it. The memory size is defined in terms of seven digit numbers so when setting the size be sure to take this into account. This does not mean that each autodial location can not hold more than 7 digits. When the memory is full, locations can be added as needed.

Format: <260>^(number of 7 digit locations)

Example: Set autodialer memory size to 100 locations

<260>^100

27. Program patch predial number - This code programs the predial number that will be dialed to access an outside line before the phone number during a PBX patch. This number should be the number that your PBX system requires to obtain an outside line.

Format: <270>^(number)

Example: Program 9 as predial number

<270>^9

28. Store macro n - This code allows a macro or string of commands to be entered into memory. This will allow the user to execute any string of codes by merely executing the "call macro n" command. Up to twenty different macros ca be programmed and accessed. The code is followed by the macro number and then the number of the code to execute. Any data required by the code should be included after the code number (separated by pounds). The user codes are selected by their number only while the P.C.L. codes need to have a star preceding their number.

Format: <280>^(macro number)^(code string)

Example: Program macro 1 to set timer 1 to 30 seconds

<280>^1^*100^0030

Program macro 2 for remote base transceive and remote base frequency of 146.52 Mhz. simplex.

<280>^13^14^146*52^1

29. Program alarm macro A-D - This code programs the four macros associated with alarm inputs A - D. When these inputs are

triggered, the macro will execute. There are four limited selections for the alarm events which are as follows: 1) announce alarm over repeater, 2) autodial number and announce alarm, 3) turn user channel off or on, and 4) say message.

Format: <290>^(1-4)^(alarm event selection)

1 - Alarm input A
2 - Alarm input B
3 - Alarm input C
4 - Alarm input D

Alarm Events

1 - Announce alarm over repeater
2 - autodial number and announce alarm
3 - Turn I/O channel on/off
4 - Say message n

The last three selections need data or a selection to be entered after them (see respective user codes).

Example: Program Alarm macro to announce alarm over repeater and turn I/O line 1 on.

<290>^1^3^1^1

30. Store configuration - This code allows all of the current operating parameters of the repeater to be saved to memory. There can be as many as twenty of these configurations stored in memory which can be called up at any time by the control operator. All of the programmed parameters can be saved at once with this code.

Format: <300>^(configuration number)

Example: Store current configuration in location 1

<300>^1

31. List configuration - This code will allow the owner to check the current configuration of the controller. All response is in voice. This can be done over the radio or the phone but in the former case the controller will not list the access codes. This prevents others from finding out the access codes.

Format: <310>^(1-3)

1 - List parameters

2 - List Codes
3 - List Parameters and codes

Example: List controller programmed parameters

<310>^1

32. Set timer event - This code allows the owner to specify a time and date followed by a specific user code or P.C.L. code to be executed. This allows the user to automatically control the repeater or change operating parameters using the clock/calendar. As with the macro command, the user code numbers are entered directly however, the P.C.L. codes need to have a star preceding the code number. The code is entered followed by the event number, the time, and the code string to be executed.

Format: <320>^(event #)^MMDDYYYYHHMMSS^(code number)^

Example: Set timer event 1 to turn I/O channel three on and say message 4 on May 7, 1986 at 1:00 P.M.

<320>^1^05071986010000l^33^4^1

33. Add user - This code allows the owner to assign specific users to the controller. A user must be assigned to the system to be able to access the mailbox commands (see the add user code for more information). Each user's call sign and number are entered into the controller for mailbox and logging use. This code also allows each user to be assigned their own access codes for specific functions. The specific codes and information for each user is each programmed separately.

Format: <330>^(User number)^(1 - 8)^(code or call sign string)

1 - Enter call sign
2 - Set Toll restricts nnnnn
3 - Program Mailbox access code
4 - Program Reverse Patch Code
5 - Program autopatch code
6 - Program autopatch code (predial)
7 - Program duplex patch code
8 - Program duplex patch code (predial)

Example: Enter KE6IL as user 1

<330>^1^5^75^69^06^73^76

Program user 1 patch access code to *1

<330>^1^1^*1

34. Program time out message - This code allows a message to be programmed that will be activated when the system times out from too long of a transmission. The message can be a string of any of the words and silence durations from the R-2000 vocabulary set. The code is entered followed by the message string.

Format: <340>^(Message String)

Example: Program "repeater disabled" as time out message.

<340>^441^715^162

35. Program reset message - This code allows a message to be programmed which will be activated when the repeater resets from a time out condition. The entry format is the same as the program time out message.

Format: <350>^(Message String)

Example: Program "Please continue" as reset message

<350>^397^714^142

36. Program answer message - This code programs the message that is activated when the controller auto answers an incoming call.

Format: <360>^(Message String)

Example: Enter "Hello, Please enter code" as message

<360>^234^715^712^397^714^177^714^136

37. Program answer ring number - This code sets the number of rings on an incoming call before the controller will answer the phone line. The answer ring number can be programmed for a high

number if you do not want incoming calls to the controller.

Format: <370>^(number of rings)

Example: Program controller to answer after four rings

<370>^4

38. Program tail message n - This code allows the messages to be programmed which will be added to the I.D. on initial key up of the repeater. The messages are be activated by COS 1, COS 2/VOS 1, or COS 3/VOS 2 becoming active.

Format: <380>^(COS number)^(Message String)

Example: Program tail message for COS 1 as "220 mega hertz"

<380>^2^712^20^714^35^237

39. Program bulletin board - This code allows the system bulletin board to be programmed with a message. The message can be later listened to by any of the users by executing the proper user code. See the section on customizing your repeater for more information.

Format: <390>^(message string)

Example: Program bulletin board with "Remote base is disabled"

<390>^438^713^113^714^258^714^162

40. Enable/Disable call log - This code enables the autopatch call logging function. This function will log all calls made. The log keeps track of the start time of call, number called, user number (if any), and end time of the call. This log is useful for keeping track of autopatch use and also for billing at the end of the month.

Format: <400>^(0 or 1, 0=disable 1=enable)

Example: Enable call log

<400>^1

41. Clear call log - This code will clear all entries in the call log. This should be used when the log becomes too full or after a hardcopy of the call log has been made.

42. Read call log - This code is used to access the information in the call log. All log entries will be read back in voice when using this code. The contents of the log can be either checked according to user number or all entries can be checked at one time (see the section on multi-user capabilities for more information).

Format: <420>^(1 or 2)

1 - All users
2 - Select users

Example: Read call log of all users

<420>^1

Read call log of user 1

<420>^2^1

43. Dump call log to RS-232C - This code will dump the call log out one of the RS-232C ports. The user needs only to select the port number to which the log should be dumped. The owner can also select whether or not to dump the whole log or just a select user (see the section on multi-user capabilities and the section on the RS-232C ports for more information).

Format: <430>^(Port number)^(1 or 2)

1 - All users
2 - Select user

If the select user option is chosen the user number must be entered.

Example: Dump log of all users out port 1

<430>^1^1

Dump call log of user 1 out port 1

<430>^1^2^1

44. Enable/Disable repeater log - This code enables or disables the repeater activity log. This log is similar to the autopatch log however, it keeps track of repeater use time. The log entries are up time and down time . If users are allocated to the system the log will also keep track of any of their codes that were used and at what time.

Format: <440>^(0 or 1, 0=disable 1=enable)

Example: Disable repeater log

<440>^0

45. Clear repeater log - This code is used to clear the contents of the repeater activity log.

46. Read repeater log - This code is used to access the information in the repeater activity log. The log may be read with respect to single users (indicating what codes they used and when) or the entire log may be read. Like the read call log code, all feedback is in voice.

Format: <460>^(1 or 2)

1 - All users
2 - Select user

Example: Read repeater log of all users

<460>^1

Read repeater log of user 1

<460>^2^1

47. Dump repeater log to RS-232C - This code is used to dump the contents of the repeater log out one of the RS-232C ports. It functions exactly the same as the "dump call log" code.

Format: <470>^(Port Number)^(1 or 2)

1 - All Users
2 - Select User

Example: Dump repeater log of all users to port 2

<470>^2^1

Dump repeater log of user 1 out port 1

<470>^1^2^1

48. Program remote frequency port - This code allows the owner to specify which port the frequency information for the remotes will come from. The outputs available can be either serial BCD data, or serial ASCII data from the RS-232C port.

Format: <480>^(remote number)^(1-6)

1 - BCD Port 1
2 - BCD Port 2
3 - RS-232C-1
4 - RS-232C-2

Example: Configure remote 1 for BCD 1 data

<480>^1^1

Configure remote 2 for RS-232C 1 data

<480>^2^2

49. Program remote memory channels - This code programs the frequency for each of the two remote memory channels. There are 20 channels for each remote base. The owner enters the remote number, the memory channel number, and then the frequency data for that channel. The frequency data is entered in the same way as when programming the remote base in user level. It must be followed by a 1,2 or 3 for simplex, duplex (- offset), and duplex (+ offset).

Format: <490>^(remote number)^(channel number)^(frequency)^(1-3)

Example: Program remote 1 memory channel 1 for 146.52 simplex

<490>^1^1^146*52^1

Program remote 2 memory channel 5 for 146.76 - offset

<490>^2^5^146*76^2

50. Configure I/O port - This code allows the eight line I/O port to be configured as input or output lines for external control or for B.C.D. data for the remotes. Lines 1 - 4 are reserved for the B.C.D. data and clock outputs but may be used for control if the B.C.D. outputs are not used.

Format: <500>^(line number)^(1 - 5)

1 - Output (active high)
2 - Output (active low)
3 - Input (active high)
4 - Input (active low)
5 - BCD data port

Note that the BCD data ports are assigned to pins one and two or three and four. Configuring just one of the lines as a BCD port automatically programs both.

Example: Program I/O line number 3 for an active high output

<500>^3^1

Program I/O line 1 and 2 as a BCD data port

<500>^1^5

51. Configure alarm port - This code allows the owner to configure the 4 line alarm port. The lines are level triggered (a change in output level will trigger them) and can be either active high or active low. The code is entered followed by the line number and a 0 or 1 for high or low.

Format: <510>^(line number)^(0 or 1, 0=active low 1=active high)

Example: Set alarm port line 1 for active high input.

<510>^1^1

52. Configure RS-232C ports - This code allows the two RS-232C ports to be configured. The baud rate, parity, word length, and stop bits can be set for each of the two ports.

Format: <520>^(port #)^(baud rate)^(1-5)^(word length)^(stop bits)

1 - No parity

2 - Even Parity
3 - Odd parity
4 - Mark parity
5 - Space parity

Example: Set RS-232 port 1 for 1200 baud, no parity, 8 bit word length, and no stop bits.

<520>^1^1200^1^8^0

R-2000 Remote Diagnostic Commands

1. ROM checksum - This code performs a checksum on the read only memory. It will respond with "test passed" or checksum error. A failed test indicates a possible firmware problem. Contact the factory if this test fails.

2. RAM checksum - This code performs a checksum on the system RAM (random access memory). It will respond with either "test passed" or "test failed". A failed test indicates a possible memory problem.

3. RS-232 diagnostics - This test allows the owner to check the two RS-232C ports. A cable must be connected between RS-232C 1 and RS-232C 2 before the test can be executed. The controller will respond with either "test passed" or "test failed". A failed test indicates that one of the RS-232 ports may be bad.

4. Audio test tone on/off - This code will send a 1 khz. test tone signal which can be used for setting system levels or troubleshooting.

Format: <640>^(0 or 1, 0=off 1=on)

Example: Turn 1 khz. test tone on

<640>^1

5. COS test on/off - This feature allows COS adjustments to be made. When the code is on, the controller will generate a tone out the monitor whenever the COS is active.

Format: <650>^(0 or 1, 0=off 1=on)

Example: Turn COS test on

<650>^1

6. System hard reset - This code will force the system to execute a hard reset. This will clear all registers and initiate the controller with all the original default values. This code should only be used when the owner wishes to clear all memory or if the system becomes hung up. The code needs to be entered followed by a 0 or 1 to abort or continue and then two stars. This is to protect the owner from accidentally executing this code.

Format: <660>^(0 or 1, 0=abort 1=continue)^**

Example: Execute hard reset.

<660>^1^**

Customizing Your Repeater System

The following section described all of the P.C.L. codes of the R-2000 and their basic format. Most of the codes are strictly related to repeater operating parameters and are straightforward to use. This section will discuss the group of codes which can help you to customize the repeater system to your needs. These basic codes give the user great flexibility in setting up and maintaining the R-2000 and allows each owner to personalize their controller. The specific features that will be discussed are repeater messages, macro commands, alarm macros, time functions, and multi-user capabilities.

Repeater Messages

In addition to the messages in response to commands, the R-2000 has several other messages which can be programmed by the owner. These messages are programmed using the proper P.C.L. code discussed in the previous section. The messages are "built" by the user using words from the R-2000 vocabulary list which can be found in appendix I of this manual. Using the proper P.C.L. code the user enters in a string of numbers from the word list. The R-2000 vocabulary list contains over 300 letters, numbers, and words. Several silence durations are also provided so that the user can vary the duration between words. The types of messages that can be programmed are as follows:

Custom messages - Up to ten custom messages are available to be used by the mailbox or they can also be read back in the user mode by executing the "say message n" code. The custom messages may also be used as announcement or warning messages by executing them via the timer event or alarm macro functions. The messages are programmed using the proper P.C.L. code. The messages are numbered from 11 to 20 to follow after the pre-programmed controller messages.

Bulletin Board message - This message is designed to be programmed by the owner with messages of interest to all users. It is activated by executing the "say bulletin board message" user code.

Time out and reset messages - A transmission of length exceeding the value of the time out timer will force execution of this message and cause the transmitter to stop transmitting. It is factory programmed to say "time out" but can be changed if desired. The reset message is executed when the person who caused the time out stops transmitting and the repeater returns to normal operation.

Answer message - This message is sent over the phone line only when the R-2000 auto answers the phone line. It is factory programed to say "Hello - please enter code" but any message can be programmed by the user.

I.D. message - In addition to just entering the call sign when using the program call sign P.C.L. code, words from the vocabulary list can also be added. These words will be announced in the order programmed during a voice I.D. however when in the C.W. mode they will be ignored. This feature allows the system to have an informative I.D. message as well as just the call sign of the repeater.

Tail Messages - The tail messages are activated when the repeater is brought up after being idle for ten minutes or more. These messages will be tagged on at end of the normal C.W. sequence. A separate message is assigned to each COS input except for the control receiver.

All of these programmable messages can be custom tailored to your needs and can give your repeater system it's own "personality". The owner should take some time to try programming various messages. The duration between words is fairly critical for a natural sounding message. At first , programmed messages may sound awkward, but with some practice you will be able to construct messages with ease.

Macro Commands

The macro store and call commands allow the user to enter in a string of commands which can be called up at any time. These codes will execute exactly as if entered from the keyboard except very rapidly. The normal speech messages will be deleted however, an acknowledgement that the macro has been executed successfully will be given. Any User or P.C.L. code can be entered by using the code number to indicate user codes and the code number preceded by a star for all P.C.L. codes. The password to access the P.C.L. level need not be used when entering a P.C.L. code in the code string for the macro.

This code is very useful in that it allows the user to store frequently used code sequences. For example, if the owner wishes to set up a different state of the repeater two different timer values, for instance) he may do so by storing a macro of the code sequence required to set up each state. Once saved, the control operator may call up this macro, instantly changing the state of the machine.

Using the macro capabilities of the controller, the owner can access and program the controller faster than if all the codes have to be entered singly. This feature is especially useful for executing the codes which require strings of data to be entered in after them.

Alarm macros - The alarm macros are identical in operation to the regular macros however, there is a limited amount of codes that can be executed. The following selections can be made when programming an alarm macro.

1 - Announce alarm over repeater
2 - Autodial number and announce alarm
3 - I/O line on/off
4 - Say message n

The first two selections are exclusive to the alarm macros. The first code will announce an alarm condition over the repeater. The second will autodial a number and announce the alarm when the phone is answered. It should be entered followed by the phone number that you want the controller to dial. Two numbers can be entered after this selection so if the first number does not answer, the controller will dial the second number. Both of these alarm announcements are latching and must be reset using the "reset alarm" user level control code.

The second two selections work the same as the user level codes with the same name. They need to be followed by the I/O line number or the message number. These last two selections are also not reset when the reset alarm code is executed. The alarm macro can be a string of these selections, allowing an elaborate alarm sequence to be programmed. For instance, the controller

could autodial a number, say a message, and turn an I/O line on to activate a bell or siren.

Time functions

The R-2000's real time clock/calendar can be used to trigger the execution of certain user level and P.C.L. codes. These codes will execute exactly as the macros discussed previously. The timer events are programmed using the "set timer event" P.C.L. code. This function can be used to execute any command at a programmed time and date. The timer event is set by first entering in the time and date followed by the specific function that you wish to execute at that time. Note that not all variables need be entered for the timer event function. Any of the input variables such as year, day, and date can be omitted. If only the time is entered for instance, the timer event would occur every day at that time. This is useful in setting up events that repeat at fixed intervals. For instance, a message can be programmed to repeat every evening at 6:00 PM by just entering 6 p.m. for the time. Then every time it is 6 p.m., the timer event will execute and the message will be announced. Either user codes or P.C.L. codes can be entered in the code string just as they are for the macro function. User codes are entered by number and P.C.L. codes are entered by their number preceded by a star.

This feature is very useful and can be used in many ways. For instance, it can be used to announce the bulletin board message at certain times or dates. It can also be used to bring up a remote on a certain frequency at a certain time for linking purposes.

The following codes will not execute under real time clock control:

User code numbers: 1-11, 16, 17-20, 25-27

P.C.L. code numbers: 1, 4, 5-7, 15-18, 20-22, 25-39, 48-50

Refer to the numbers from the user and P.C.L. code list. These codes are restricted from being executed under timer control either because they are not needed or to prevent certain system parameters from being changed. Notice that all User level control codes can be put under timer control.

The time functions are very useful for providing automatic control of your repeater system . Operating parameters such as timers, PL mode, etc. can be programmed to modify themselves at certain times.

Multi-user Capabilities

The R-2000 has the provisions for allocating individual users to the system. This allows each user to have a mailbox number and a select set of personal user codes. The multi-user capabilities also allow the autopatch and repeater log to keep track of each user's autopatch calls and keep track of certain user codes that any user executes. It also allows the system to page a specific user by call sign when a reverse patch is activated. The owner uses the "add user" P.C.L. code to enter in the user's call sign and to allocate his user codes. The following is a list of all user codes and variables that can be assigned when adding a user:

1 - Call sign
2 - Toll restricts
3 - Mailbox Access Code
4 - Reverse Patch Code
5 - Autopatch connect code
6 - Autopatch connect code (predial)
7 - Duplex patch connect code
8 - Duplex patch connect code (predial)

The call sign is entered in the same format as when programming the system call sign (see P.C.L. codes). The toll restricts are entered in in the exact format as the "select toll restrict" P.C.L. code.

The multi-user capabilities allow the owner to assign specific codes to each user and to log all user activity both on the repeater and autopatch. They also provide each user with their own personal subset of codes.

INTERFACING THE R-2000 TO OTHER DEVICES

In addition to controlling the operation of your repeater system, the R-2000 also has the capability of controlling other external devices. An eight line input/output port is provided to allow the user to turn external devices on or off and also read the status of incoming signals. Access to any of these lines can be had by executing the proper user level control code. These codes can be also made to execute via the timer functions for time variable control of these lines. This could be used for turning the outside lights on at 6:00 PM every night, for instance. The first four of these I/O lines can also be used to provide serial BCD information for the two remote bases, if required. In addition to these I/O lines, four alarm inputs are provided and, when activated will cause the execution of one of the alarm macros. These can be programmed to turn a user channel on or off (activating a siren or bell), announce the alarm over the air, or initiate a call and announce the alarm over the phone (see section on alarm macros for more information). Finally, the R-2000 has two RS-232C ports for interfacing it to computers, modems, printers and certain computer controlled transceivers. The following sections will discuss each of these features in detail.

The Input/Output Lines

The eight input/output lines can be used to either control or monitor external devices. The lines are T.T.L. level compatible and the user must provide the interface between these lines and devices such as relays. See appendix II for information on how to interface devices to these lines. Appendix II also contains an illustration of the I/O line connector pin assignments. Before using the line, it must first be configured using the "configure I/O line" P.C.L. code. Then the line may be accessed by executing the "User Channel n On/Off or Status" command. If the device was configured as an input, only the "User Channel Status" command will work.

The first four input lines can be alternatively assigned as BCD data outputs using the proper P.C.L. code. These lines are reserved for that purpose. Pins one and two are BCD data for remote one and pins three and four are BCD info for remote two. Each one of these BCD ports consists of a clock line and a data line. The data can be converted to parallel format by using two serial in parallel out shift registers. See appendix II for BCD data output format and interface schematics.

Alarm Inputs

Four separate alarm inputs are provided for connection to external switches or logic signals (see appendix II). Each of the four inputs has it's own macro assigned to it which will be executed as soon as the alarm switch is opened or closed (see the section on alarm macros for more information). The alarm inputs can be armed by use of the proper user level control operator code. The alarm input levels can also be tested by using the "alarm switch test code". This can be done either to check inputs or to see which alarm input has been activated during an alarm condition. The alarm macro can be programmed to do four things: 1) Announce the alarm over the repeater, 2) autodial a number and announce the alarm when the phone line is answered, 3) Turn a control line on or off, or 4) say a message. The first two selections are latching and must be cleared by using the reset alarm command. The last two selections function the same as their respective codes and cannot be reset.

The RS-232C Ports

The R-2000 has two RS-232C Ports which can be used to transfer data to and from the controller. These ports are configured using the "configure RS-232 port" P.C.L. code. They have selectable baud rate, word length, parity, and stop bits (see the section on programming the ports for more information). The default setting of the ports is 1200 baud, no parity, eight bits, and no stop bits. The ports can be used for interfacing the R-2000 to a terminal or computer with a "com" program (this sets up the computer as an ASCII terminal). When hooked to a terminal the user just hits "return" a couple of times and then the screen will display "R-2000 Control > " as a prompt. The user then keys in any code just as he would from the keyboard. The return key is used to enter any command. The R-2000 will respond to the codes with one line messages, or prompts for data if required by the code.

A serial printer can be hooked to one of the ports to obtain hardcopy printouts of the log information contained in memory. Upon entry of either of the "Dump Log" codes the R-2000 will send the data out the specified port. Refer to your owners manuals for information regarding setting up the ports and the connections needed.

Finally, certain computer controlled transceivers can be connected to this port. The controller supports the Kenwood format. The controller sends frequency data only to the transceiver. Consult the appropriate Kenwood user's manual for details on configuring your port and the cable required.

Appendix I - R-2000 Vocabulary List Version 1.0

Number	Word	Number	Word	Number	Word
0	0	39	charlie	81	P
1	1	40	delta	82	Q
2	2	41	echo	83	R
3	3	42	foxtrot	84	S
4	4	44	golf	85	T
5	5	46	hotel	86	U
6	6	46	india	87	V
7	8	47	juliet	88	W
7	8	48	kilo	89	X
9	9	49	lima	90	Y
10	10	50	mike	91	Z
11	11	51	nancy	92	active
12	12	52	oscar	93	access
13	13	53	papa	94	again
14	14	54	quebec	95	ahead
15	15	55	romeo	96	alarm
16	16	56	sierra	97	alert
17	17	57	tango	98	and
18	18	58	uniform	99	answer
19	19	59	victor	100	arm
20	20	60	whisky	101	at
21	30	61	x-ray	102	auto
22	40	62	yankee	112	battery
23	50	63	zulu	113	base
24	60	65	A	114	baud
25	70	66	B	115	busy
26	80	67	C	132	call
27	90	68	D	133	cancel
28	hundred	69	E	134	celsius
29	thousand	70	F	135	channel
30	million	71	G	136	code
31	nano	72	H	137	command
32	micro	73	I	138	communication
33	milli	74	J	139	complete
34	kilo	75	K	140	configuration
35	mega	76	L	141	connect
36	giga	77	M	142	continue
37	alpha	78	N	143	control
38	bravo	79	O	144	correct

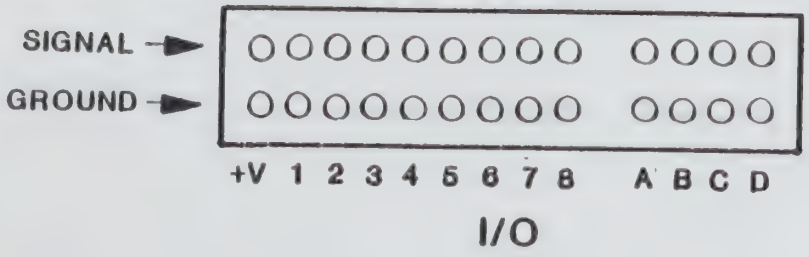
Number	Word	Number	Word	Number	Word
152	data	235	help	355	normal
153	date	236	here	356	north
154	day	237	hertz	372	o'clock
155	default	238	hit	373	of
156	degree	239	home	374	off
157	delay	240	hour	375	on
158	demonstration	252	important	376	open
159	dial	253	in	377	operator
160	digit	254	interface	378	over
161	disable	255	intrusion	379	out
162	disabled	256	intruder	392	pad
163	disarm	257	invalid	393	page
164	duplex	258	is	394	patch
172	east	259	it	395	per
173	emergency	292	key	396	phone
174	enable	293	keypad	397	please
175	enabled	312	last	398	plus
176	end	314	later	399	point
177	enter	315	level	390	power
178	entry	316	light	391	pound
179	error	317	line	392	pulse
180	exit	318	link	393	pulses
192	fahrenheit	319	limit	412	quarter
193	failed	320	listen	413	question
194	failure	321	logging	414	quit
195	feet	322	low	432	range
196	fire	332	macro	433	re-
197	for	333	mark	434	ready
198	frequency	334	master	435	receive
199	from	335	me	436	received
212	get	336	message	437	receiver
213	go	337	minus	438	remote
214	going	338	minute	439	repair
215	good	339	module	440	repeat
216	goodbye	340	monitor	441	repeater
217	ground	341	mode	442	reset
218	group	342	mute	443	restrict
232	hang	352	near	444	reverse
233	have	353	need	445	ring
234	hello	354	no	452	second

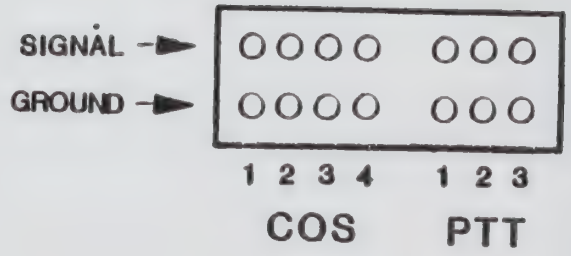
Number	Word	Number	Word	Number	Word
453	security	533	waiting	714	sil 320ms
454	select	534	want	715	sil 640ms
455	send	535	warning	720	/
456	set	536	was	721	C.W. space
457	sign	537	watt		
458	site	538	week		
459	south	539	welcome		
460	speed	540	west		
461	star	541	what		
462	station	542	will		
463	status	543	with		
464	system	544	word		
472	temperature	545	work		
473	test	572	year		
474	thank	573	yes		
475	that	574	you		
476	the	575	your		
477	then	592	zone		
478	this	612	-ed		
479	time	613	-ed		
480	timer	614	-ed		
481	toll	615	-ed		
482	tone	616	-er		
483	total	617	-er		
484	touch	618	-er		
485	transceive	619	-er		
486	transmit	700	-er		
487	try	701	-ing		
492	unattended	702	-ing		
493	unit	703	-ing		
494	up	704	-s		
495	use	705	-s		
512	value	706	-th		
513	version	707	-uth		
514	voice	708	sil 5ms		
515	volt	709	sil 10ms		
516	voltage	710	sil 20ms		
517	volts	711	sil 40ms		
518	vote	712	sil 80ms		
532	wait	713	sil 160ms		

Note: locations 720 and 721 are C.W. characters only.

Appendix II - COS, PTT, I/O, and Alarm Connections

This appendix contains information about the COS, PTT, I/O, and alarm inputs. An illustration of the connectors is provided. Also contained in this appendix is information on interfacing devices to the I/O, alarm, and BCD ports.





I/O:

V – 5V

1 – INPUT/OUTPUT LINE 1 (ALSO BCD1 CLOCK)

2 – INPUT/OUTPUT LINE 2 (ALSO BCD1 DATA)

3 – INPUT/OUTPUT LINE 3 (ALSO BCD2 CLOCK)

4 – INPUT/OUTPUT LINE 4 (ALSO BCD2 DATA)

5 – INPUT/OUTPUT LINE 5

6 – INPUT/OUTPUT LINE 6

7 – INPUT/OUTPUT LINE 7

8 – INPUT/OUTPUT LINE 8

A – ALARM INPUT A

B – ALARM INPUT B

C – ALARM INPUT C

D – ALARM INPUT D

PTT:

1 – COS INPUT FROM REPEATER RECEIVER

2 – COS INPUT FROM REMOTE 1 (OPTIONAL)

3 – COS INPUT FROM REMOTE 2 (OPTIONAL)

4 – COS INPUT FROM CONTROL RECEIVER

COS:

1 – PTT OUTPUT TO REPEATER TRANSMITTER

2 – PTT OUTPUT TO REMOTE 1

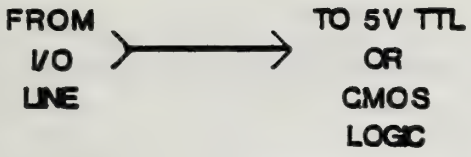
3 – PTT OUTPUT TO REMOTE 2

DIGITAL I/O, COS, PTT PINOUTS

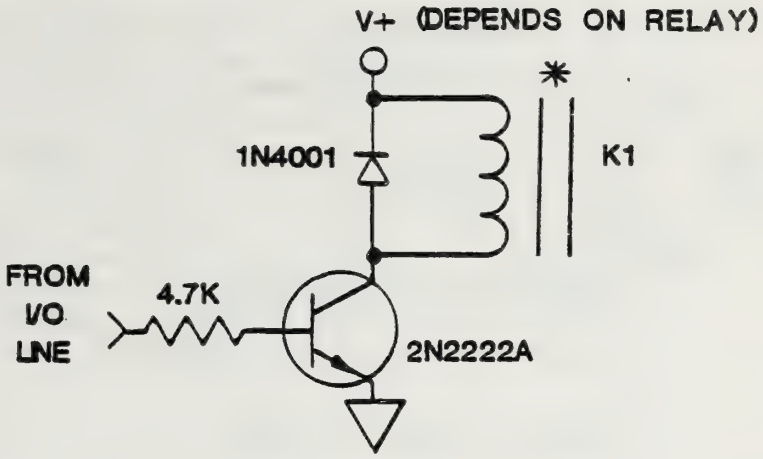
I/O AND ALARM PORT – INTERFACE CIRCUITS

OUTPUTS

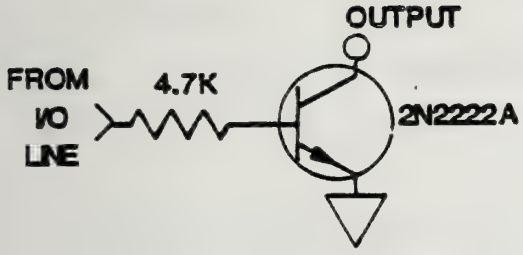
DIRECT



RELAY



OPEN COLLECTOR

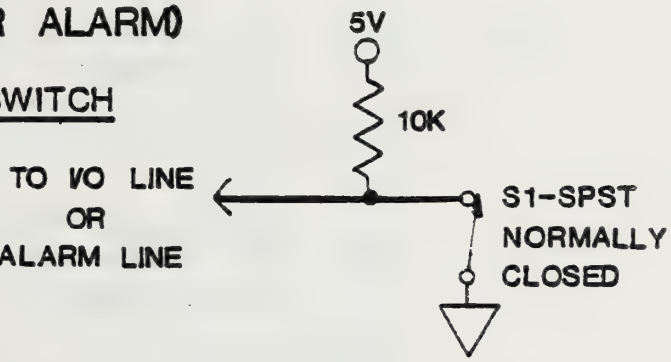


* CHOOSE CONTACT CONFIGURATION AND VOLTAGE/CURRENT RATINGS TO SUIT APPLICATION.

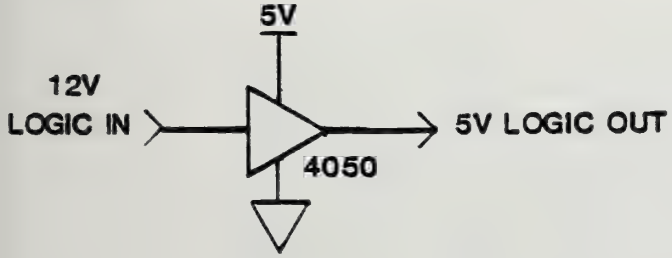
INPUTS (I/O OR ALARM)

DIRECT

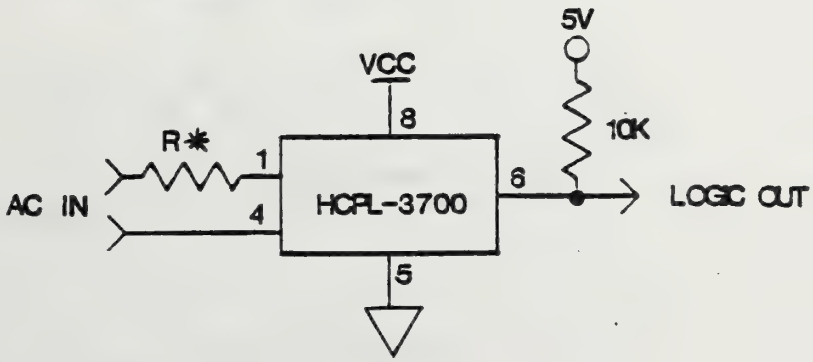
SWITCH



12V HIGH LOGIC

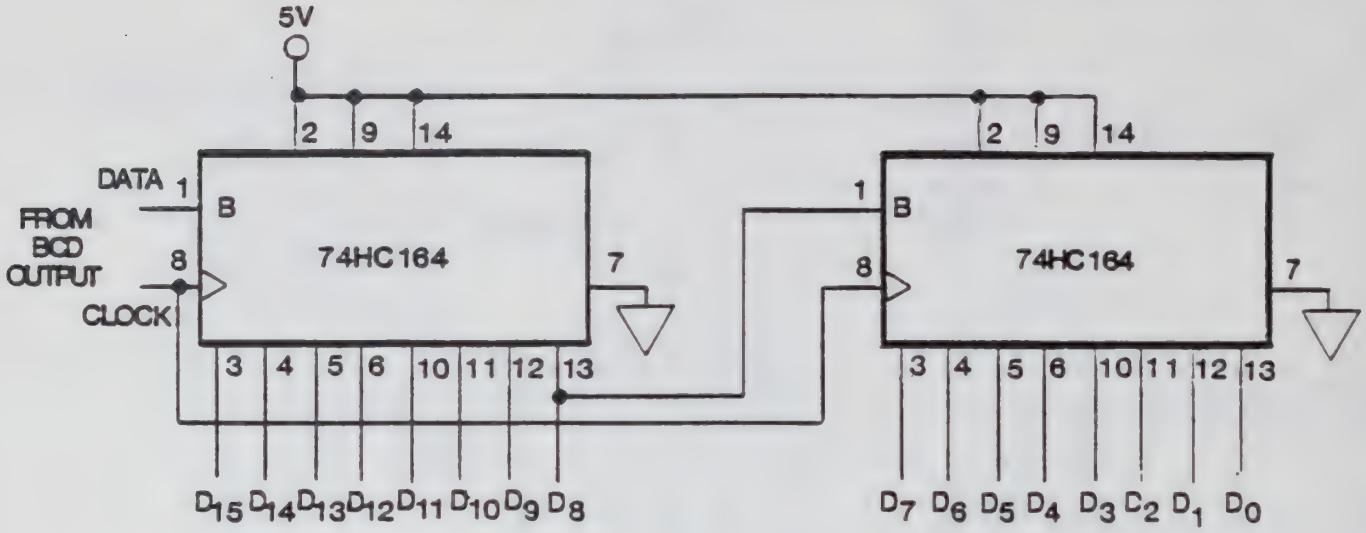


A.C. SENSE



* SEE HP OPTOELECTRONICS CATALOG FOR MORE INFO

BCD PORT – INTERFACE AND SIGNAL NAMES



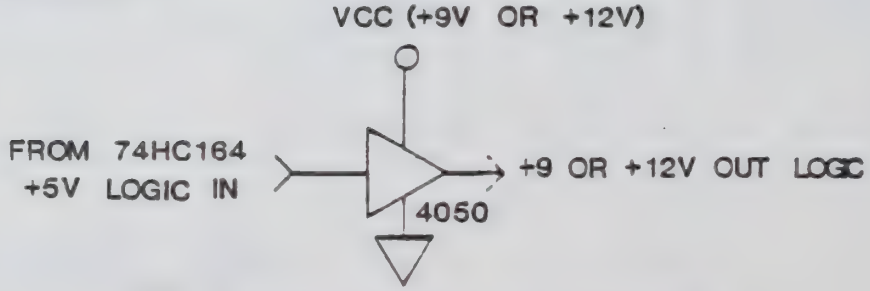
SHIFT REGISTER DATA

D_{15}	D_{14}	D_{13}	D_{12}	D_{11}	D_{10}	D_9	D_8	D_7	D_6	D_5	D_4	D_3	D_2	D_1	D_0

D_{15} – 1 MHZ (MSB)
D_{14} – 1 MHZ
D_{13} – 1 MHZ
D_{12} – 1 MHZ (LSB)
D_{11} – 100 KHZ (MSB)
D_{10} – 100 KHZ
D_9 – 100 KHZ
D_8 – 100K (LSB)

D_7 – 10 KHZ (MSB)
D_6 – 10 KHZ
D_5 – 10 KHZ
D_4 – 10 KHZ (LSB)
D_3 – $\overline{0}$/+5
D_2 – $\overline{\text{DUPLEX}}$/SIMPLEX
D_1 – $\overline{-}$/+
D_0 – NC

LEVEL CONVERSION



USE 1 GATE FOR EACH OF 16 LINES

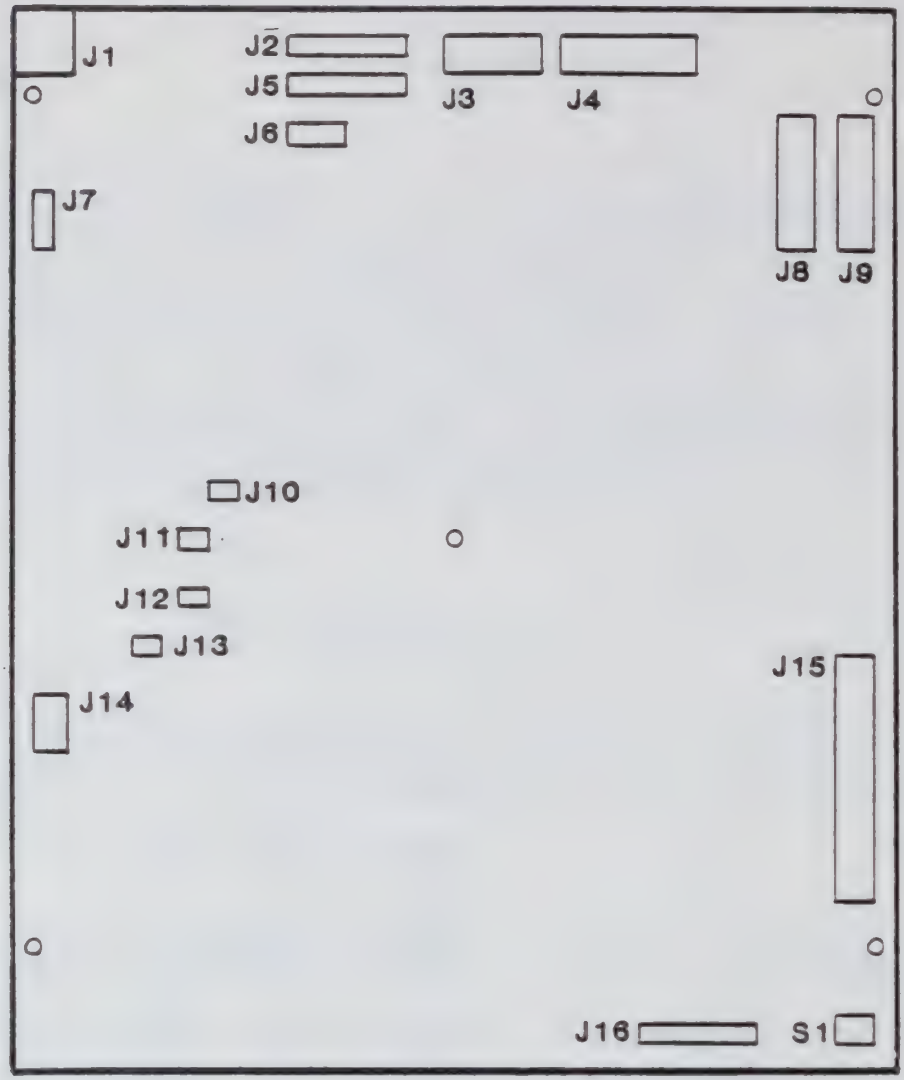
Appendix III - In Case of Trouble

The R-2000 has been constructed from high quality parts and has undergone extensive testing to bring you a trouble-free product. However, if you have a problem with the R-2000, it should be easy to remedy the problem. The status display is an important indication of the controllers condition. If any problems are encountered, check to see if the RX LED lights and the DV LED lights when touch-tones are sent to the controller. Inspection of the display may indicate an external equipment failure (no COS, no audio, broken connections, etc.). The following is a list of possible problems and their possible causes.

Symptom	Possible Cause
Controller dead	No Power, faulty power connection, blown fuse.
No audio	Faulty audio cable, RPT OUT level set too low.
No receive audio	Faulty audio cable, RPT IN level set too low.
Distorted receive audio	RPT IN level set too high.
Not transmitting	Bad PTT connection. COS threshold set incorrectly. No COS input.
Autopatch "try again" message	Faulty phone connection, dead phone line.

If the problem still exists after checking all connections, cables, and signals, the controller may have failed. The unit may be returned to the factory for repair or, at option to the owner, our board exchange program can be used. Contact the factory for more information. The P.C. board of the R-2000 is easily removed for servicing. A diagram showing all connector locations is on the next page. To remove the board, first remove the screw holding the voltage regulator to the chassis near edge of board. Then remove all connectors from the board. Finally, remove the five mounting screws. The board can then be removed and shipped to us in the appropriate container for repair.

R-2000 P.C BOARD CONNECTOR DESIGNATION



J1 - MODULAR PHONE JACK
J2 - REPEATER, REMOTE1 AND CONTROL AUDIO
J3 - COS/PTT CONNECTOR
J4 - I/O AND ALARM CONNECTOR
J5 - AUDIO BUS (FOR EXPANSION ONLY)
J6 - REMOTE 2 AUDIO
J7 - TO LOCAL MIC CABLE
J8 - TO RS-232C-1 CABLE
J9 - TO RS-232C-2 CABLE
J10 - TO MONITOR POT ON/OFF SWITCH
J11 - TO SPEAKER
J12 - TO MONITOR POT CABLE
J13 - BATTERY BACKUP ENABLE (DO NOT REMOVE!!)
J14 - TO POWER CABLE
J15 - MICROPROCESSOR BUS (FOR EXPANSION ONLY)
J16 - TO DISPLAY BOARD CABLE
S1 - TO POWER SWITCH CABLE

GLOSSARY

active high - A logic signal that, when active, is at a high voltage state.

active low - A logic signal that, when active, is in a low voltage state.

alarm input - An input to the controller which, when activated, forces the execution of a macro. These inputs can be used for site security as well as for triggering the controller on external events.

ASCII - American Standard Code for Information Interchange. The commonly used digital code for communicating between computers and peripherals.

autodial - A software controlled function which generates the touch-tones for dialing a phone number very rapidly.

autopatch - A device which provides a link between handheld or mobile transceivers and the phone line. This allows calls to be made via a radio link.

baud rate - The speed of data being sent over the RS-232C port.

BCD - Binary coded decimal. This is the common data format for synthesized radios with thumbwheel switch frequency control.

bit - A single unit of digital data. The data can be either a one or zero (active or inactive).

byte - Eight bits.

bulletin board - A message buffer on the R-2000 which is used for storing messages of interest to all users.

CMOS - Complimentary Metal Oxide Semiconductor. An integrated circuit technology which offers low current and high speed operation.

COS - Carrier Operated Switch. The signal which can be found in most F.M. radios which indicates that a signal is being received. This signal is usually taken from the squelch circuit and changes voltage levels when a signal is being received.

code - A numerical value assigned to each of the user, control and program functions of the controller. These codes are entered from the touch-tone pad to execute controller functions.

controller - A device which ensures the correct operation of other hardware. The R-2000 is a repeater system controller.

control operator - The person responsible for ensuring the correct operation of the repeater system. This person also has access to all of the R-2000 control codes.

control receiver - A receiver used only for touch-tone control of the repeater system.

courtesy tone - A delayed tone provided by the controller at the end of each received transmission. This allows breaking stations to interrupt before the tone. This feature also allows identification of the input being received by assigning different courtesy tone sequences to each COS input.

CPU - Central Processing Unit.

C.W.- Continuous Wave. A morse code transmission.

default - The factory set value of a code or parameter before it is by the owner reprogrammed.

DTMF - Dual Tone Multi-Frequency. Technical name for touch-tone type signaling.

duplex - Mode of communication where both paths of the conversation are broadcast simultaneously.

duplexer - A series of filter cavities used for separating the receive frequency from the transmit frequency . This allows the use of one antenna for both transmit and receive.

firmware - A computer program that has been stored in read only memory (a ROM or EPROM).

hang time - The time the controller keeps the transmitter keyed after the receive signal goes away.

hard reset - A reset which forces all variables to default values and clears all registers. Should only be used when the owner wants to erase all reprogrammed parameters.

I.D. - Stands for Identification. The FCC requires that all repeaters and transmitters under remote control identify themselves with the station call sign at intervals no greater than ten minutes apart. The R-2000 identifies in either morse code or voice.

I/O - Input/Output. The way that computers are interfaced to other devices is by the I/O. This is used for interfacing the COS, PTT, and control lines on the R-2000

macro - A set of codes that are executed frequently. The R-2000 macros enable the user to store strings of user or P.C.L. codes and later execute them with one command.

off hook - The state of the phone interface when on line during a call.

on hook - The state of the phone interface when not on line.

open collector - A transistor output capable of sinking current in the on mode and providing a relatively high impedance when off. This is used on the R-2000 for keying the transmitters.

parity - An error checking scheme used when data is transferred via the RS-232C ports. Parity can be either even, odd, mark or space. One can also send data with no parity if error correction is not required.

PBX - Private Branch Exchange. A private switching network maintained by businesses for the interconnection of many phones or extensions.

P.C.L. - Program Control Level. The level of the R-2000 that can be accessed for reprogramming controller parameters.

P.L. - Private Line. A sub-audible encoding scheme used for providing limited access to the repeater. Several P.L. modes are available on the R-2000 for providing system security.

pound - The '#' character on a touch tone keyboard. Also refereed to as the sharp character.

program - A set of instructions that a computer executes to perform a specific task.

PTT - Push to talk. The input signal to a transmitter that causes it to transmit when activated.

RAM - Random Access Memory. Memory which can be written to or read from by a microprocessor or computer.

remote base - A remotely controlled transceiver. This is located at the repeater site and can be accessed through the main repeater channel. Remote bases allow users on other frequencies access to the repeater.

repeater - A system consisting of a receiver, transmitter, controller, and antennas which receives a signal on one frequency and rebroadcasts it on another frequency. A repeater can increase the normal range of mobile or handheld transceivers.

reverse patch - A phone call to the repeater system. Must be answered by a user on the repeater system.

RS-232C - A standard serial communications port used for interfacing printers and other devices to a computer.

simplex - A mode of communications where only one side of a conversation is transmitted at one time .

soft reset - A reset that clears all registers yet retains all other data for parameters and codes in memory.

speech synthesizer - An integrated circuit capable of reproducing human speech.

squelch tail - The burst of noise heard from the receiver when the transmitting station unkeys.

star - The '*' character on a touch-tone keypad.

sub-audible tone - Same as PL

sub-audible tone decoder - A decoder used for detecting sub-audible tones from the receiver.

time out timer - A timer that limits the maximum transmission length of the repeater system. This prevents a continuous signal from locking up the repeater transmitter.

toll restrict - A feature which prevents long distance calls from being made on the autopatch.

transceiver - A radio transmitter and receiver in the same package which share common circuitry. Usually limited to simplex operation.

T.T.L. - Transistor Transistor Logic. A integrated circuit technology. The R-2000's I/O and alarm lines are compatible with T.T.L. logic.

user level - The level of the R-2000 which allows voice communications through the repeater and and allows access to the user codes.

VOS - Voice Operated Switch. Provides an output when a voice is received on the input. The R-2000 contains digital VOS circuits for the remote bases and the phone line.